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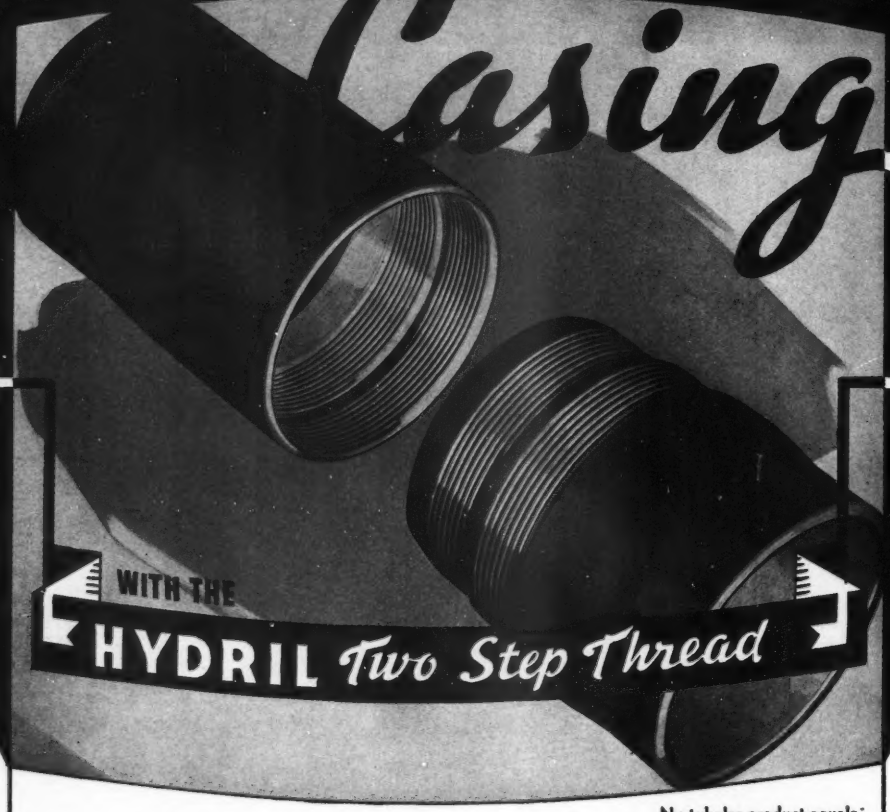

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CALIFORNIA
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NOVEMBER 12, 1936
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Coming Events

Nov. 7-16—A.I.M.E. Western Meeting, Mexico City, Mexico.

Nov. 20—Mid-Continent Oil & Gas Assn. Annual Membership Meeting, Tulsa, Oklahoma.

Nov. 30—Independent Petroleum Association of America, Seventh Annual Meeting, Oklahoma Biltmore Hotel, Oklahoma City, Okla.

Nov. 30-Dec. 4—American Society of Mechanical Engineers, Annual Meeting, New York.

Dec. 1—Interstate Oil Compact Commission Meeting, Oklahoma City, Okla.

Dec. 4—Mid-Continent Oil & Gas Association, Texas Division, Houston, Texas.

Dec. 5-13—First International Consumers Petroleum Exposition, Convention Hall, Detroit, Mich.

Dec. 18—Tentative date for annual Christmas Jinks of Calif. Oil & Gas Assn. Wildcat Committee. The place, Biltmore Hotel, L. A. The Wildcats promise better and funnier entertainment than ever, including an original play.

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A RECENTLY completed refinery is not only making gasoline, but is also making "dynamite" for the entire oil industry on the Pacific Coast.

After a comparatively long period of marketing stability, with prices of gasoline established at reasonably profitable levels, a flood of distress gasoline has been turned loose—and that gasoline is being sold at almost any price, the refiner in question making no attempt to control the retail price of his product, especially that part of his output which is being sold to distributors and not under his own name or through his own pumps.

The result is that other refiners, especially the smaller independents who market their gasoline through distributors or brokers, are being driven to the wall, and will, if history repeats itself as it always has under similar conditions in the past, start marking down the prices of their own gasoline, and the old practice of giving gasoline away will start all over again.

Under present conditions, with the refiner making no attempt to control the price of his no-brand gasoline, the dealers in most cases are operating at a margin of less than one cent per gallon—and the result of that will unquestionably be the breaking of hundreds of dealers. The dealers say that they can't control the market. If the refiner who sells to them doesn't force them to keep prices stable, they are not strong enough to keep prices stable by themselves.

Further, it seems strange that this one refiner, who has so long condemned secondary marketing, should now, when this practice has been cleaned up by all the larger companies, resort to marketing the same gasoline through a multiplicity of brands at discriminatory prices. Such discrimination is certainly most damaging to the large group of independent dealers who have so long provided a stable outlet for his gasoline.

A movement is underway to force all dealers to stabilize their prices, but the success of the move is not assured, and the blame for the present weakness in the market can be laid squarely at the door of one refiner in the Los Angeles Basin.

There is more to this gasoline war than that it will ultimately, if allowed to continue, bring the price of gasoline to a ridiculous figure.

There is no way known to the oil industry—or to man, for that matter—to maintain crude conservation and reasonable crude prices when gasoline prices drop to levels below certain well-defined limits in relation to crude prices, and while it always takes time for low gasoline prices to affect crude, it is inevitably true that when gasoline prices drop, and stay low for a long enough time, wasteful production of crude commences and as a result crude prices also break, and then the whole industry—big producer, little producer; big refiner, little refiner; big marketer, little marketer—all start to lose money, and lose it in direct ratio to the time elapsed during the price war and to the ruinous levels to which prices descend.

Why the whole industry must suffer because one refiner has a mistaken idea as to what constitutes marketing; why refiner, marketer, producer, distributor—all must pay for the folly of one company, is one of the unfortunate conditions surrounding the life of a highly competitive industry. Nevertheless, that is one of the conditions and the smaller refiners as well as distributors are beginning to lose gallonage, pumps, and distributing outlets. One refiner is making the whole oil industry face a period of profitless operation—and all because he has not been able to recognize the fact that there is only a certain market for gasoline in California, and if one refiner expects to increase his sales, those increased sales must be taken from someone else.

The smaller refiners are already losing out, but as yet there has been no effect on the producer. He has not yet found his prices being lowered; his outlets being taken away, but it is only a matter of time, and of short time at that, until the present measure of crude conservation will be affected, with the consequent effect on crude prices, if the gasoline market is not soon stabilized.

The producer is not entirely blameless, either. He has not been curtailing his production to the level recommended by the Central Committee, even though that committee developed an annual rather than seasonal average. He has been adding oil to storage except for a few months—and with demand naturally and inevitably lower during the winter months, he is in a precarious position even without a gasoline war. Stocks were not drawn upon during the months when crude production, if held to the 544,000-barrel allotment, would have required some withdrawals from storage, and at the winter rate of demand, stocks were to be added to even at a 544,000-barrel rate of production.

With a burden of storage that is still too great, even though it has been reduced from the peak figures of 1929 and 1930, with the known fact that demand for all products is bound to decrease during the next three months, with the practical certainty that additions will be made to storage even though the 544,000-barrel quota is met (and with no assurance that the quota will be met) just how long will it take a gasoline war to break the crude price schedule?

When the industry has seen gasoline demand reach levels never before attained, and at prices that meant at least some if not adequate profits to the industry; when demand is great enough to assure every refiner's share of the market and its profits, there is no excuse for trying to get more than that share at a cost that is measured in terms of disaster to the whole industry. Disaster to the whole industry means that the refiner that started the crack-up will also suffer to as great a degree as anyone else.

Basin Gasoline Prices Weakening; 12.9-Cent Signs Showing Increase

ONE OF THE GRAVEST conditions that has faced the California oil industry for many months is facing it today. Gasoline prices, which have been reasonably stable since the first of April, are crumbling under a flood of distress gasoline that is being manufactured by one refiner in the Los Angeles Basin and sold at a rack price of 11½ cents, with no restrictions as to its ultimate price to the service station or to the consumer. This gasoline is being bought by brokers and distributors, some of the latter being owners of one or two tank trucks who sell it at prices that net them $3 or $4 for a day's work, and is sold to dealers at a price averaging about 12 cents per gallon. These dealers are selling the gasoline to the public at 12.9 cents per gallon, which leaves them a margin of less than one cent per gallon.

The result is that this gasoline is breaking the third structure market, and other independent refiners and marketers, who are mantaining a tank wagon price of 13 cents and a retail price of 16 cents are losing all their gallonage, and, in some instances, their distributing outlets and service-station pumps.

One corrective measure has been taken. The Retail Petroleum Dealers Association, Inc., has served notice upon a number of stations displaying 12.9 cent signs that if they continue to sell gasoline at that price, the Association will enter suit under the California Fair Trade Practices Act, which prohibits the selling of an article at a price less than that necessary to insure a fair profit. The Association, after a survey of some 40 service stations, arrived at a figure of 15% of the gross price as the minimum cost of doing business, which, applied to the present wholesale cost of gasoline, would pring the minimum retail price to 13.9 cents per gallon. The Association recognizes that this figure is the minimum, and that a reasonable profit would be earned by selling gasoline at 16 cents per gallon, which is the price demanded by all independent refiners and marketers for dealers who are selling their branded third structure gasoline.

However, if the Association is forced to go into court to stop the selling of gasoline at 12.9 cents. it must be prepared to prove that gasoline cannot be sold at a profit at less than the figure it maintains is necessary, hence the 13.9-cent minimum.

A further effect of the condition is that, in addition to the refiners and service-station owners, it is also creating chaotic conditions in the distributing and brokerage phases of the industry. Independent refiners have been maintaining a rack price of 11¾ cents per gallon, but have, in addition, been demanding that the tankwagon price be maintained at 13 cents, and the retail price at 16 cents. The refiner who has upset the applecart has set a price of 11½ cents at his rack, not serious in itself, but has made no restrictions as to the other two prices. The result is that his gasoline has been delivered to the service station at about 12 cents—an immediate one-cent differential—and has been sold, because no definite margin for the dealer was insisted upon, at 12.9. The distributor, in this case, has been operating for approximately one-quarter to one-half cent per gallon, instead of 1¾ cents as insisted upon by other independent refiners.

The margin for the distributor is not sufficient to pay his operating expenses, except in the case where he is, as previously mentioned, satisfied with a day's wages at a low figure.

The final effect will undoubtedly be another price war, unless the condition is immediately corrected. No independent refiner is going to allow his outlets to be taken away from him without a struggle, and the only struggle possible is through competitive price cuts—which is the way all price wars start.

If a price war does start, it will soon affect crude conservation and price schedules—and when that happens, the California oil industry will again be in for a period of wasteful and futile operation.

Geologists Hold 13th Annual Meeting; Elect Officers; 275 Members Attend

THE THIRTEENTH ANNUAL meeting of the Pacific Section, American Association of Petroleum Geologists, convened last Thursday and Friday at the Biltmore Hotel, Los Angeles. The meeting was very well attended, with some 275 interested spectators filling the Music Room of the Biltmore.

The annual meeting was the occasion for the presentation of numerous papers of considerable interest to those men responsible for the discovery of sufficient new oil reserves to replace those fields whose declining yields have reduced the visible oil reserves of California to the point where another leasing and development campaign is now under way.

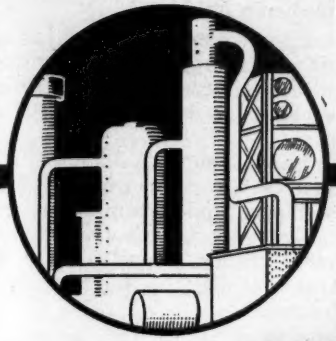
Luis E. Kemnitzer spoke on "Geology of San Nicolas Island, California," an exposition devoted chiefly to a discussion of the geological details of the region. Another paper was presented jointly by H. D. Hobson and W. D. Rankin, entitled "Notes on the Stratigraphy of the Sespe Creek - Piru Creek Area." "Geoelectric Exploration in the Tejon Ranch Area, California" was the subject of another paper offered by J. J. Jakosky and H. K. Armstrong, who compared the geophysical predictions made of this area with the actual results obtained by drilling. "Connate Water in Oil Sands" was the subject of a paper presented by Howard C. Pyle, who explained the importance of the presence of this water and the need for linking both porosity and permeability in any estimation of the potential commercial production of any specific well. Francis D. Bode delivered a paper on "The Geology of the Eastern Half of the San Joaquin Hills, Orange County, California."

"The Geological Causes of Poor Reflection Records," was a paper in which Frank Rieber commented on the unsatisfactory records obtained in certain types of formations, and who presented a method of overcoming some of the difficulties involved. Olaf P. Jenkins spoke on the "Progress of Geologic Branch of the California State Division of Mines," and discussed the various publications issued in the past few years by that body and the geologic maps planned for the immediate future. Bruce L. Clark discussed the "Migration of Oil Along Fault Zones."

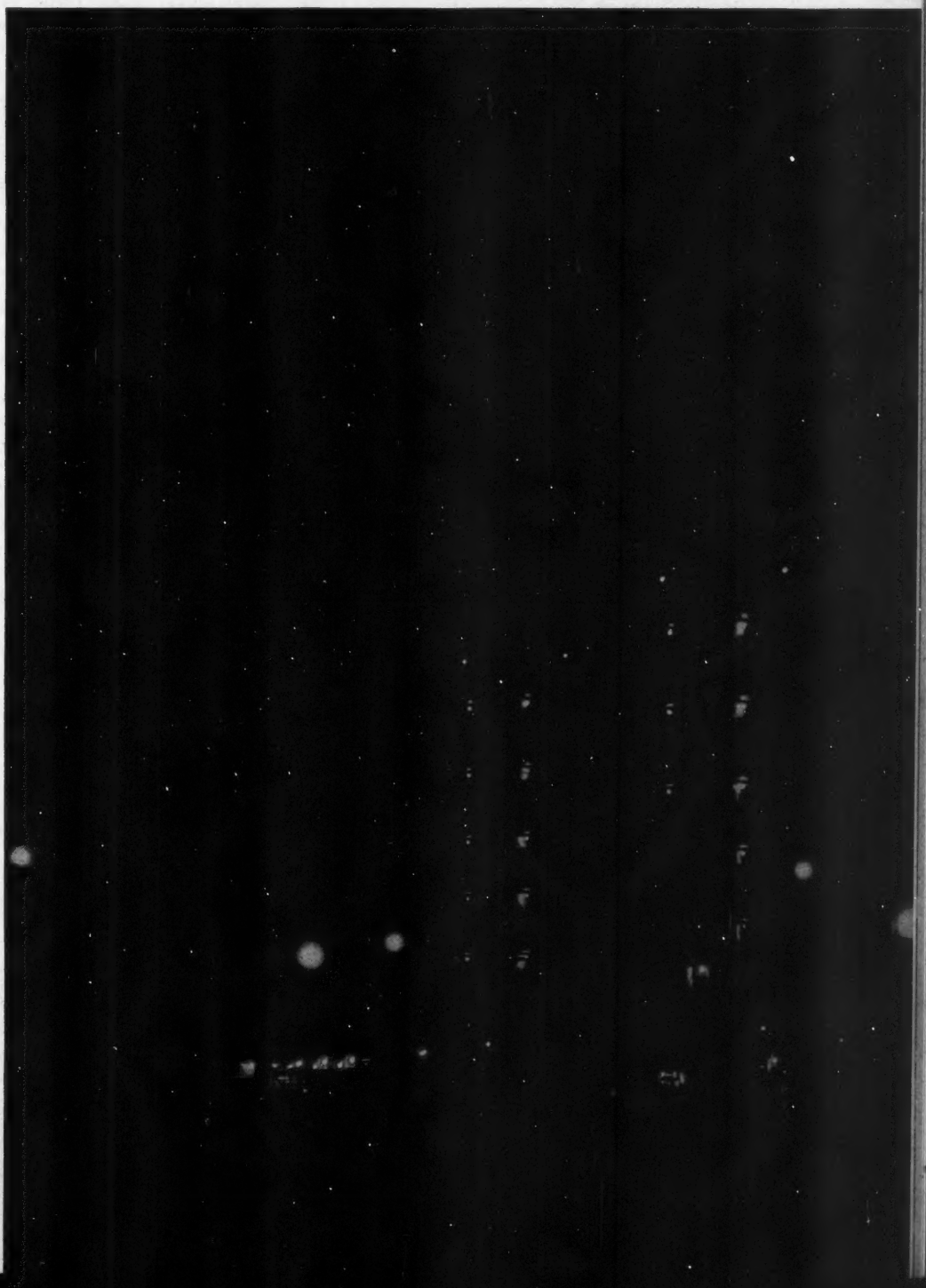
Paleontologists Meet

On Thursday evening the Pacific Section of the Society of Economic

(Continued on Page 29)



Refining



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By
Herbert Lyman Emerson

High Temperature Corrosion

By Arthur Marks
Consulting Metallurgist

THE PARTS OF THE plant affected by high-temperature corrosion are those parts operating above the condensing temperature of water, viz., heating tubes, transfer lines from heater, reaction chambers, flash and rectifying towers.

Free Sulfur and Sulfur Compounds

Free sulfur formed from the decomposition of sulfur compounds in the crude has been shown to have a very great direct action upon iron by E. Retailliau and F. R. Lang [1] in a carefully conducted series of experiments. There is no doubt of the direct action of sulfur on iron in the absence of moisture. On the other hand, there is evidence that a water film may play a part in some high-temperature and high-pressure operations. Where, for example, calcium hydroxide ($Ca(OH)^2$) or sodium hydroxide (NaOH) is introduced into the system as a neutralizer, the water thus added may play an important part which will be discussed under the heading of neutralizers.

An analysis of the series of tests of some 25 ordinary and special steels conducted in various plants by the committee does not show any direct relation between the amount of corrosion and the percentage of sulfur in the crude; in fact certain crudes relatively low in sulfur showed greater attack on the steels than some crudes higher in sulfur.

A most interesting series of tests on this point was conducted by placing blanks of SAE 1020 steel in a Cross reaction chamber and in a Dubbs reaction chamber—the former running a crude containing 0.685 percent sulfur, and the latter running a crude containing more than 1 per cent of sulfur. The only other variable factor in these tests was the pressure, which is discussed later.

The mean loss of metal for all the sample in the former case was 17.5 g. per 1,000 hours' exposure, and in the latter case 7.98 g. per 1,000 hours' exposure. This is a convincing illustration of the fact that the percentage of sulfur in the crude is not necessarily a direct measure of its corroding power—a conclusion with which every experienced chemist will agree.

This would indicate the probability of the sulfur playing a cyclic function in the attack on the iron, and further laboratory and plant researches along the lines of the work of Messrs. Retailliau and Lang would help in the complete elucidation of the part which sulfur plays in the destruction of the metal. In the meantime it can be stated that, whether direct or indirect action occurs, it is probably the most active material encountered in high-temperature corrosion.

The work of Wood, Sheely, and Trusty [2] with solutions of various sulfur compounds in naphtha at room temperature is also of importance. They showed that:

a. Mercaptan sulfur is most corrosive, forming mercaptides of iron and copper.

b. Hydrogen sulfide is very reactive, forming iron and copper sulfide.

c. Free sulfur is quite inactive with iron, but corrodes copper and brass.

d. Other sulfur compounds are only slightly corrosive.

e. In all cases corrosion is accelerated by the presence of water.

Other investigators, as, for example, Wilson and Bahlke,[3] have shown that free sulfur and hydrogen sulfide are very active above 700 deg. F., but their action is negligible below 500 deg. F. The coating of iron sulfide formed slows down the reaction, but does not stop it completely. The scale is loosened by heating and cooling, and by erosion.

Although the sulfur content of the oil cannot be accepted as an indication of the corrosion rate, as shown above, the general conclusion is that high-temperature corrosion is caused by free sulfur, mercaptans and hydrogen sulfide, wnich are produced by the high temperature of the stills on the more complex sulfur compounds originally present in the cold feed. Further work is desirable at high temperature and pressure to investigate the part which steam may play in the reaction.

Naphthenic Acids

Recent work has shown that organic acids may be an important factor in high-temperature corrosion of equipment handling California crudes.

Seligman and Williams[4] have shown that organic acids—such as acetic, proprionic, palmitic, stearic, and oleic—react with aluminum at a low corrosion rate at 200 deg. F., but at 570 deg. F. the reaction is quite rapid.

The reaction rate is apparently independent of oxygen concentration, but is greatly influenced by the presence of water. The addition of 0.05 per cent of water practically stopped corrosion, due no doubt, to the formation of a stable oxide film which is relatively insoluble in acid and alkalies. These results must be interpreted in the light of the relative solubility of aluminum oxide in acid and alkali, as hot acid and hot alkali will dissolve aluminum oxide. This question of relative solubility and mass of the reacting materials is too frequently lost sight of. For example, barium sulfate is relatively insoluble in water—in fact, one of the most insoluble substances—and in dilute ferric chloride; but its solubility in more concentrated solutions has led to some great blunders in the determination of sulfur in steels. Although the work of these researches deals with aluminum, the reactions are also possible with iron; and a knowledge of the work of the food-packing industry on this subject, no doubt, be helpful—the carboxylic group (COOH) containing a replaceable hydrogen atom, would at once be suspect in high temperature corrosion.

Vuiborov[5] has shown that napthenic-acid corrosion is experienced with Russian crudes, and Blount[6] has shown that the asphaltic crudes of California containing naphthenic acids are very corrosive at high temperature — the lower molecular-weight acids being more active than the higher-molecular-weight acids, from light and heavy lubricating distillates, respectively.

Laboratory tests showed that the pure acids at 650 deg. F. penetrated steel specimens 0.058 in. per year at 5.5 per cent concentration, and 0.203 in. per year at 16.5 per cent

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The author discusses the fundamentals underlying corrosion in refineries. The paper was presented at the 1935 A. P. I. Meeting

concentration. Copper alloys were more resistant than steel, and the chrome steels were practically inert to naphthenic-acid corrosion.

The influence of corrosion products in the refined product is also important. Blount[6] has shown that copper naththenate and copper mercaptide, with pressure distillates containing as low a concentration as one part per million, produce striking degradation in color. Several corrosion reports show that less doctor reagent is required in treatment after neutralizers have been used in processing.

Inorganic Acids

The principal inorganic acids met with in processing are hydrochloric and sulfurous acids, which are active in the presence of water. Hence, their effect is mainly noticeable in the lower-temperature sections of the plant, such as in the rectifying towers. Any action they may have in the high-temperature sections of the plant is, no doubt, masked by the more active elements in those sections.

The factors influencing high-temperature corrosion are probably as complex as the nature of the chemical reactions taking part.

Pressure and Temperature

An examination of the steel corrosion tests conducted by the committee in various plants failed to show any direct relation, except perhaps in the case of plain carbon steels, SAE 1020, used as comparison blanks.

The mean temperatures in the two series were approximately 900 degrees F., with a variation of 20 deg. to 25 deg. above and below this figure. The pressures were, however, 700 lb. where the rate of corrosion was 17.5 g. per 1000 hours' exposure to crude containing 0.685 per cent sulfur, and 175 lb. where the rate of corrosion was 7.98 g. per 1000 hours' exposure to crude containing more than 1% of sulfur.

These results would indicate that pressure is the primary factor in the corrosion. Probably the hydrogen-sulfide gas is the active agent being compressed or generated under pressure. One has only to correlate these figures with the modern pressure processes for the synthesis of ammonia to realize that both pressure and temperature may play a more important part in the corrosive process than the actual percentage of reacting substances, such as sulfur; as there is always present more sulfur even in the low-percentage crudes than it is desired to see taking part in the corrosive action, as evidenced by the flow of the excess to subsequent parts of the plant.

The results stated above showed that increasing the pressure by four times doubled the corrosion, even in the presence of a smaller quantity of sulfur.

Erosion

Several reports from members deal with erosion of headers in tube furnaces. This case may be profitably considered in detail.

When the oil flows through the straight portions of the tube in a tube still, the particles of oil close to the wall of the tube are slowed in their travel by the skin friction of the surface of the tube, which is greater than the friction between the particles of the oil. Hence, there is a natural tendency for the remainder of the oil being prevented from making contact with the surface of the tube. The number of particles touching the surface of the tube at any section kill, therefore, be proportional to the internal circumference of the tube.

When the oil reaches the header, a change of direction occurs, and the straight streamline flow is upset. Particles at the center and between the center and circumferential row of particles flow to the circumference, so that the sum of all the particles of oil at the cross-section can now make contact with the metal. Since in any chemical or corrosive action the amount of action is proportional to the reacting masses, a much greater contacting of oil per square inch of metal surface occurs at the header than in the tube and, hence, a much greater corrosion.

In this connection, consider as a contrast a case of pure erosion, as for example, in a sand-blasting plant. Here the particles of sand move in a stream of air with no cushioning or lubricating effect. The particles of sand themselves are inelastic (for practical purposes) and, hence, the force developed by their sudden stoppage by a surface of metal may rise to infinity. As is well known, the action is sufficiently powerful to erode or to break off mechanically particles of steel from a steel surface.

This may occur in still tubes owing to the loosening of fine coke particles on re-cycle of cracking stock. Its action is modified according to the degree of vaporization occurring. In a complete liquid-phase process the oil will tend to cushion and lubricate the particles striking the wall of the header, but there is obviously the probability of mechanical erosion by the coke particles. The substitution of a cast chromium-steel header gives increased resistance to both erosion of this kind, on account of its greater hardness, and also to corrision on account of its more inert chemical character.

General Conclusions Relating to High Temperature Corrosion

The general conclusions regarding high-temperature corrosion may be summarized briefly:

1. Sulfur and its compounds are the primary reactive substances.

2. Their influence is a function of temperature and pressure, rather than of percentage of sulfur in the material being processed.

3. The higher pressures, coupled with the high temperature in liquid-phase cracking, result in local overstress of the metal and increased rates of corrosion.

4. Mechanical erosion, due to loosened coke particles travelling at high velocities, may increase the rate of corrosion where a change in direction of flow occurs owing to actual mechanical removal of protective corrosion products.

5. The influence of moisture in the crude should be studied further. In this connection, the remarkable economic results in blast-furnace practice for the manufacture of pig iron, by removal of water from the air entering the furnace, are deserving of close consideration.

Protective Methods for Combating High-Temperature Corrosion

Use of Correct Materials of Construction

As has been indicated in an informal manner during the discussion of corrosion, a primary factor of corrosion is the tendency of the metals to return to a more stable state under the conditions in which they are giving useful service.

The natural course would, therefore, be to seek for a material which is stable or is highly resistant to attack by corrosive agents. Considerable advance has been made in this direction, owing chiefly to the demands of the synthetic-ammonia and the oil-cracking industries.

The ancient injunction, "seek and ye shall find," is still true, and the findings are infinitely greater owing to the simultaneous development of research tools, so that results of the searchings are accruing at a compound-interest-law rate.

The chemical factor which has to be met in high-temperature high-

pressure processes in the refining industry is the affinity of sulfur and its compounds for the metals.

In the high-temperature sections of the plant, therefore, metals are required of adequate mechanical strength so that the metal thickness will not be unduly great and, consequently, have a high temperature-stress factor, and be heavy and expensive. The structural form must comply not only with adequate capacity, but with a minimum bending and creeping at the high temperatures used, and a maximum bursting resistance to withstand the pressures.

Once the high - temperature strength factors are known, these structural requirements can be calculated.

The heat of formation of the sulfur compounds of the metals may be taken as a guide in their choice; but, in the first place, naturally the engineer has taken the cheapest and strongest metal for construction, viz., steel, and asks for improvements as temperatures and pressures are increased

The metals which unite with sulfur, forming sulfides with low heat of formation, readily form sulfides; and, conversely, the sulfide readily undergoes decomposition.

For instance, in the case of the most useful commercial metal iron, the sulfide easily forms under increasing temperature and pressure, but is also easily decomposed at the same temperature by reducing the pressure below that of the atmosphere.

Aluminum with a high heat of formation of its sulfide has been tried as a lining for expansion chambers and drums subject to corrosion by sulfur gas, but not with any marked degree of success as reported in the corrosion reports—due, no doubt, to other factors, particularly the mode of application, etc.

The most successful material so far tried has been the high-chromium iron alloys. These are both resistant to sulfur corrosion and, by the addition of suitable quantities of nickel and reduction of the carbon content to a minimum, are, generally speaking, structurally strong.

Chromium - nickel - iron alloys have, therefore, been used with considerable success as still tubes and as linings for the vapor space of forged-steel drums and reaction chambers, but have not been universally favored.

The loss of metals may be due not only to direct combination with sulfur, but also to the part which oxidizing agents, such as water, may play in the high-temperature parts of the plant.

The heat of formation of the oxides of the metals may, therefore, be considered in this connection.

The results of the corrosion committee's experiments may be usefully considered in the light of these figures.

For example, simple nickel-iron alloys, and high-nickel with low-chromium content alloys, were among the group of highly-corroded metals.

The figures for the heat of formation of the oxide of chromium, together with its high-tensile properties, are confirmed by both the corrosion committee's tests and by experience. With regard to aluminum, the results have been successful in some cases and failures in others. For example, "calorized" tubes of recent manufacture appear in some reports as giving satisfaction. In this connection, the low density of aluminum should not be overlooked.

The border-line results shown by the molybdenum and tungsten steels indicate the need for further development by the addition of increasing percentages. Apart from their direct influence, their indirect influence in dissolving carbon, and so preventing the deposition of carbides on the crystal boundaries of the alloys during continued heating, is important.

Frequent references are made in the corrosion reports to the presence of magnesium chloride in the crude from which hydrochloric acid is formed by dissociation. The heat of formation of the chlorides of the metals in connection with their resistance to corrosion in high-temperature parts of the plant should be considered. Water is frequently present.

One of the most important questions in high-temperature corrosion relates to whether conditions in the heater tubes, reaction towers, and drums is oxidizing or reducing. The presumption generally is that the conditions are of oxidizing character.

The major reaction taking place is that of the direct union of sulfur with the metal. On the other hand, views have been expressed as to the possible action of aqueous films, and these are entitled to consideration. The presence of water or steam at the high temperatures used would indicate the possibility of the formation of sulfuric acid by oxidation of the sulfur which attacks the iron to form a sulfate of iron is readily dceomposed at relatively low temperatures, and the fact that the final product is iron sulfide does not preclude the possibility of this cycle reaction. In this connection, the varying results reported with calorized tubes are worthy of further investigation.

The corrosion reports show different degrees of success and failure with alloy steels, and there is no general and decisive view as to the economic necessity for any particular composition.

Some reports show that technical and economic requirements are met with 18 Cr-8 Ni steel, while others show preferences for both 4-6 Cr and plain carbon steel. Carbon-molybdenum tubes are preferred for high temperatures with little corrosion, and chrom-molybdenum tubes for corrosive conditions in cracking stills.

It is evident from the corrosion reports that the steel which most economically meets the corrosive action of the particular crudes being handled is the one to use. Generally speaking, there is no majority tendency toward the use of high chromium-nickel alloys. Some members have not found calorized tubes better than plain carbon steel, while others show satisfactory results by the use of 4.6 per cent chromium steel, with 0.4 to 0.6 per cent of molybdenum. Other chromium steels are on trial.

It would probably be an advantage to have a definite maximum depreciation figure per 1000 bbl. of distillate gotten out as a guide in the choice of the more expensive metal with its increased life.

In the large-diameter sections of the high-temperature plant, such as expansion and reaction chambers and drums, both linings of high-chromium steel and plain carbon steel with chromium plating have been tried. The greatest practical difficulty encountered has been in the correct attachment of special linings. Coke is formed between the lining and the walls of the chamber, with resulting buckling and inefficient contact; but, nevertheless, quite advantageous results have been obtained.

One report —on the use of 18 Cr-8 Ni plates in forged steel tube drums giving a life of 18 months—favors the use of corrosion-resistant metal of this composition. Other reports indicate that successful protection

can be obtained with sprayed aluminum, where the aluminum is put on with the electric torch and not with the oxyacetylene spray.

Anyone familiar with the oxidizing action of the spray gun will at once see that the metal was probably oxidized and ruined before it was put to use; the electric torch, being much less oxidizing than the oxyacetylene torch, gave a successfully coated surface.

Chromium plating has been tried with some success in large high-temperature vessels. Considerable improvement has been effected in the application of chromium plating by improvements in the electrolyte and the distribution of the anodes when plating. The greatest defects in chromium plating have been the formation of pin holes and lack of adequate contact with the steel. The majority of the corrosion reports indicate that the most practical and successful method of protection has been by the use of metal linings attached by riveting and electric welding.

Non-metallic linings have been used in some high-temperature sections of the plant, soaking drums having been lined with 2 in. of concrete with successful results. Fractionating towers have been successfully lined with both gannister and acid fire brick, as well as with cement attached to the tower by means of expanded metal. An "acid-character" material such as gannister would be theoretically the better type, as the neutralization of alkali in a cement lining results in "spalling"—which anticipated result is indicated as having occurred in several reports. The action of magnesium salts on concrete would also anticipate the probability of spalling occurring, in view of the reported presence of magnesium salts in many crudes.

Added Chemical Reagents—Neutralizers

The use of a neutralizer is probably the simplest and most practical method of suppressing corrosion. This is shown clearly in the corrosion reports.

The three neutralizers employed in various plants were caustic soda, lime, and soda ash.

The chemistry of the process of neutralization as applied to high-temperature corrosion probably includes the following reactions:

1. Combination of the neutralizer with sulfur and sulfur compounds.
2. Suppression of the hydrolysis and dissociation of the less stable chlorides.
3. Neutralization of the naphthenic acids.

Caustic soda and caustic lime unite with sulfur and with dydrogen sulfide.

The majority of the reports show a preference for using lime rather than caustic soda or soda ash. It is the cheapest, but sometimes results in off-specification fuel oil. A consideration of the heat of formation of the sulfides may be of value in connection with these results.

Heat of Formation of the Sulfides

Sodium sulfide is more readily formed, but not so stable as calcium sulfide; and calcium oxide (lime) is theoretically the best neutralizer to use. The general conclusion from experience is that caustic soda is more efficient than calcium oxide (lime), combining more readily with sulfur and also improving the quality of distillates; but precautions against embrittlement of the steel, degeneration of fuel oil and asphalt quality are necessary. Ammonia is not satisfactory in high-temperature portions of the plant—the sulfide being less stable and, if formed, readily dissociated. The use of caustic soda undoubtedly introduces serious operating hazards and, hence, the general practice has tended toward the use of lime as the most practical neutralizer for high-temperature corrosion. The report of the Sub-committee on Neutralizers, of Nov. 9-11, 1931, deals fully with the subject.

The problem of caustic embrittlement of the steel has been investigated by Williams and Homerberg,[7] and others. Generally, the tendency has been to attribute the action to the absorption of hydrogen and the reduction of sulfides and oxides at the crystal boundaries of the metal. While this action may be true, the simple explanation that there is alkali corrosion occurring during which the segregates and impurities at the boundaries are dissolved is the more probable explanation—an alkali-corrosion cell being formed. The supression of caustic embrittlement, by suitable treatment of the metal in the course of manufacture has been held back by the ancient specification for the numerous varieties of boiler plate on the market under the various names of "still" steel and the like. The idea that a dead soft steel is the best for resisting alternating stress is till prevalent in the mind of the mechanical engineer who overlooks the fact that not only caustic embrittlement, but also alternating-stress fractures, start at places of minor weakness in the steel, i.e., at slag lines and at crystal boundaries where impurities thrown out during crystallization are deposited.

Quantity of Neutralizer Required

Lime: The reports show that most of the refiners used between 0.1 and 1.5 lb. of lime per barrel of crude charged, and in one case (Kansas crude) as low as 0.02-0.03 lb. of lime per barrel of crude.

The amount added has been controlled generally by the condition of the coke, working for coke deposits which are just alkaline. The net results in the corrosion loss has been stated to be a reduction of from 25 per cent to "complete inhibition of high-temperature corrosion" — the latter statement being made in regard to the cracking of high-sulfur oil. One operator who used from 0.6 to 1.5 per cent of lime reported that the quantity used was too much. In that case, protection of heater tubes and towers was from 80 to 95 per cent effective.

Caustic soda: This is introduced in water solution of from 15 deg. to 25 deg. Baumé gravity. The quantity used varies from 0.09 to 0.25 lb. per barrel processed.

Chamber corrosion was reported as being reduced 48 per cent, and in other cases iron in the distillates was reduced 80 per cent. One case reported corrosion entirely eliminated, and another case reported one severe failure due to caustic embrittlement.

The quantity required is less than in the case of lime, and appreciable improvements are reported in the distillates. The "spent" caustic soda left in residual oils gives trouble in slagging of furnace walls, where residues are burned as fuel.

It would be of advantage in the discussion of this problem if figures were available showing the condition of the residue in the coke, i.e., to what extent the alkali is in the form of sulfide, oxide, sulfate, or salts of naphthenic acids.

No doubt some members have investigated this question, and the information if available would be of value.

Ammonia: The low heat of formation of ammonium sulfide would at once indicate the probable ineffective value of this alkali in high-temperature corrosion protection. Where adequate quantities of water are present for the direct formation

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Automobile Design Influence On Natural Gasoline

By C. C. Moore, Jr., and Robert L. Stirton
Union Oil Co.

THE FINAL ARBITER of acceptable quality in gasoline is the driver of the automobile. When he pulls up at the service station and says, "Give me ten gallons", he is not receptive to a proposition to install a new intake manifold, carburetor, and fuel pump to enable him to use the specified fuel to best advantage. The ten gallons goes into the car as it stands, and if the car doesn't purr sweetly, his wrath is directed at the gasoline, not the motor designer. Consequently, the gasoline producer must design his product to fit practically all of the cars which may conceivably use it, rather than for even a majority of cars that might derive better performance from a specified fuel.

The result of this situation is that the automobile designer holds in his hands the power to direct the destiny of the gasoline industry. This power has recently been recognized, and is now exercised with some discretion and in some measure in cooperation with the technical men of the oil industry. The purpose of this paper is to review some of the effects of this co-operation in relation to the use of natural gasoline in motor fuels.

Advantages of Natural Gasoline

The advantages of the use of natural gasoline in motor fuel are largely found in the qualities of easy starting, flexibility of operation, rapid warm-up, decreased detonation, and acceleration. In these respects the performance of practically all cars on the road today can be improved markedly by the use of fuels containing larger qualities of natural gasolines. Balanced against these advantages the single major objectionable feature of fuels containing relatively large amounts of natural gasoline is their tendency to cause the phenomenon known as "vapor locking". Essentially, then, the use of increased amounts of natural gasoline in commercial motor fuels is limited only by the tendency of cars to "vapor lock" on highly volatile fuels. As automotive engineers succeed in producing cars which will not vapor lock with the more volatile fuels, the public will enthusiastically welcome such fuels and, the economic balance remaining at its present position, the gasoline producers will enthusiastically furnish such fuels.

Vapor Lock Regulation

With these points in mind, let us consider what progress the designer has made in the past few years in regulating the tendency of cars to vapor lock, and then consider what the effect of this progress, if any, has been on the volatility of fuels now offered commercially. We will also consider how much more effect such progress could have today, if the limiting volatility were closely approached, and what the prospects along these lines are for the immediate future. After these points are established, we might even attempt to deduce what the present trend in automotive design may lead to in the slightly more distant future.

Let us consider the situation as it existed three years ago. At that time it was necessary to design the gasoline to fit the cars not only of 1933 vintage, but also the cars at least as far back as 1929 and 1930.

One factor of primary importance in deciding whether or not a car will vapor lock is the maximum fuel temperature attained in the gasoline supply system of the car. Bridgeman, White and Gary[1] conducted an extensive survey in 1932-33 of cars in use at that time, and reported that the following gasoline temperatures were typical of the average car operated at 40 m.p.h. on a level road when the atmospheric temperature was 100°F.

Cars of 1930 and older	130°F.
Cars of 1931	132°F.
Cars of 1932	128°F.

Recently, MacCoull and Barber[2] and Barber and Kulason[3] have reported the results of similar measurements on a considerable number of later cars. Their results indicate the following maximum gasoline temperatures to be typical under the same conditions of operation.

Cars of 1934	136°F.
Cars of 1935	145°F.
Cars of 1936	133F°.

On the basis of these data, we can only conclude that there was no improvement as regards maximum fuel line temperatures in the six-year period. This may probably be entirely attributed to the development of the so-called "streamlined" models with high fenders, inadequate louvers, reduced frontal areas of opening, and the resulting increased under hood air temperatures. The drop of approximately 10° in fuel system temperature from 1935 to 1936 suggests the possibility of further improvement in the next few years.

Vapor To Liquid Ratio

Another factor of primary importance in influencing the tendency of a car to vapor lock is the limiting vapor to liquid ratio of the fuel system. By the vapor to liquid ratio tolerance to a fuel system is meant the ratio of the volume of vapor to the volume of liquid which can exist in the fuel supply system without disturbing the delivery of liquid fuel to the carburetor main jet. In other words, the gasoline partially volatilizes in all gasoline engine supply systems so that the fuel actually delivered to the "carburetor float bowl" always consists of a mixture of liquid and vapor. The higher the vapor to liquid ratio limiting tolerance, the more vapor the system can handle without any unfavorable influence on the operating characteristics of the engine. When the limiting tolerance is exceeded and vapor lock occurs, the operation of the engine is impaired or even discontinued.

Let us consider the trend of vapor to liquid tolerance in cars over the same period which we have considered in connection with fuel line temperatures. There exists considerable variation in this respect from car to car, and as the individual values are of interest, these data are presented in the form of a chart, in Figure 1. The data used in Figure 1 have been taken from the results of investigations of Bridgeman, White and Gary, and Barber and Kuleson.

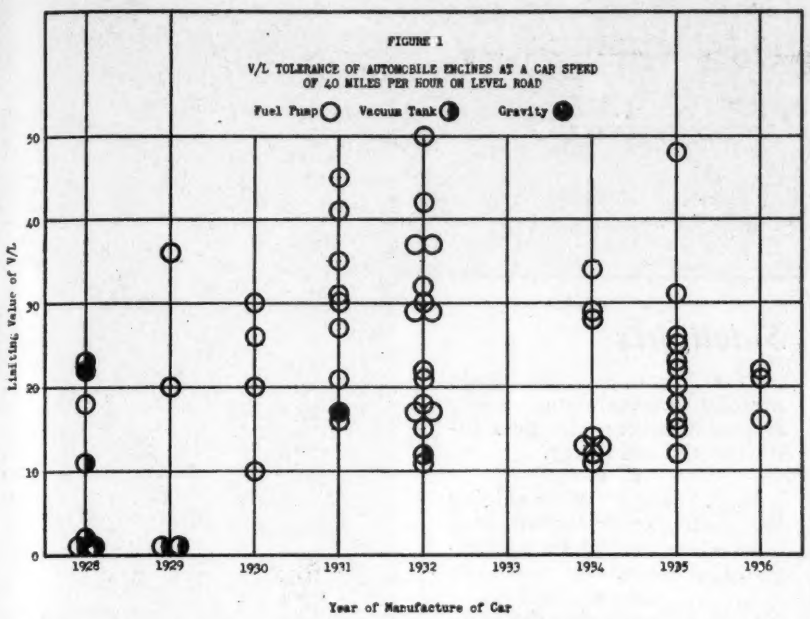
The limiting factors of automobile engine design on the use of natural gasoline blends in commercial gasoline.

C. N. G. A. paper

FIGURE 1

V/L TOLERANCE OF AUTOMOBILE ENGINES AT A CAR SPEED OF 40 MILES PER HOUR ON LEVEL ROAD

Fuel Pump ○ Vacuum Tank ◐ Gravity ●



Tolerance Increases

It will be noted in Figure 1 that the vacuum tank became obsolete with the introduction of the 1930 cars, and the "bad actors" in regard to vapor to liquid tolerance, or, at least, the worst among them, disappeared with the vacum tank. Beginning with 1930, the worst car tested by the two groups of investigators shows a vapor to liquid tolerance of 10 or more. The cars of 1935 and 1936 show a noticeable grouping around the value of 20 for the vapor to liquid tolerance. It appears from these data that considerable progress has been made by the automobile designers in raising the vapor to liquid tolerance limit. The trend seems to be toward a value of 20 for the vapor to liquid tolerance, which, we will be shown later, should be an entirely satisfactory value for all reasonable purposes.

Barber and Kulason[3] have also developed a method by means of which one can calculate the approximate Engler distillation values and Reid vapor pressure which a gasoline must exhibit in order not to cause vapor locking in a given car if the vapor to liquid tolerance and the maximum fuel line temperature to be expected under the given climatic conditions are known. Without attempting to justify this method or to explain it in detail, it will be applied to the case of typical cars for which gasoline had to be supplied in 1933 and also to the case of typical cars for which gasoline must be supplied today. In this way it is possible to arrive at specifications for the most volatile gasolines which could be marketed then and now, both for winter and summer use.

Worst Tendencies

The car representative of the worst vapor locking tendencies which had to be contended with in 1933 will be assumed to have had a vapor to liquid ratio tolerance of zero, and to have shown a maximum fuel line temperature of 132°F. when operated at an atmospheric temperature of 100°F., and 105°F. fuel line temperature when operated at an atmospheric temperature of 65°F. The most volatile gasoline which could have been used satisfactorily in the summer in this car, according to the method of Barber and Kulason, would have the following "front end" volatility characteristics:

Reid vapor pressure at 100°F., lb./sq. inch, 8.0
Temperature at 5% evaporated, °F, ...127
Temperature at 10% evaporated, °F. 142
Temperature at 15% evaporated, °F. 155
Temperature at 20% evaporated, °F. 164

The corresponding gasoline for winter use in this car would have the following characteristics:

Reid vapor pressure at 100°F., lb./sq. inch, 11.75
Temperature at 5% evaporated, °F. 105
Temperature at 10% evaporated, °F. 120
Temperature at 15% evaporated, °F. 132
Temperature at 20% evaporated, °F. 142

For comparison with the typical limiting car of 1933, the typical limiting car in 1936 will be assumed to have a vapor to liquid ratio tolerance of 25 and to show maximum fuel line temperature of 135°F. when operating at an atmospheric temperature of 100°F., and of 110°F. when operating at an atmospheric temperature of 65°F.

According to the method of Barber and Kulason, this car will tolerate gasoline of the following volatility characteristics in the summer:

Reid vapor pressure at 100°F., lb./sq. inch, 10
Temperature at 5% evaporated, °F. 113
Temperature at 10% evaporated, °F. 129
Temperature at 15% evaporated, °F. 141
Temperature at 20% evaporated, °F. 150

The most volatile gasoline satisfactory for winter use in this car would show the following values:

Reid vapor pressure at 100°F., lb./sq. inch, 15
Temperature at 5% evaporated, °F. 94
Temperature at 10% evaporated, °F. 108
Temperature at 15% evaporated, °F. 119
Temperature at 20% evaporated, °F. 127

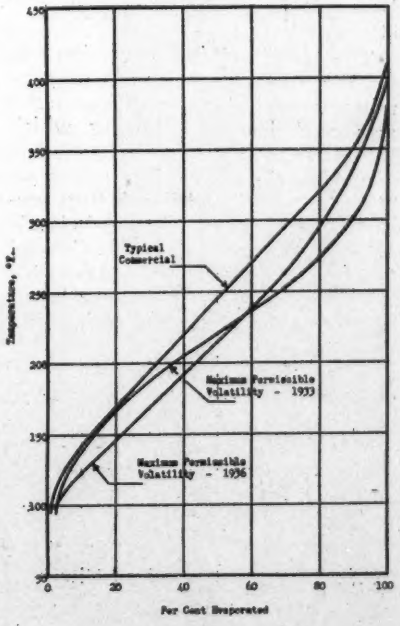
For convenience in visualizing the comparisons made above, four gasolines were prepared in the laboratory to meet these volatility specifications. The Englar distillation curves of the summer gasolines are shown, together with the Engler distillation curve of a typical commercial gasoline actually furnished to the public during the summer season which has just closed, in Figure 2. Figure 3 similarly shows the Engler distillation curves of the two winter gasoline blends.

Thus far, only the effects of the modifications in engine design on the permissible volatility of gasoline for the use in automobiles have been considered. Definite progress has been made in the direction of permissible use of considerably more volatile gasolines. It might be men-

(Continued on Page 22)

FIGURE 2

ENGLER DISTILLATION CURVES OF SUMMER GASOLINES



C. N. G. A. Fall Meeting Attended By More Than 500 Members And Guests

DRAWING a near - capacity crowd of five or six hundred members and guests, the California Natural Gasoline Association last Thursday held its regular fall meeting in the ballroom of the Biltmore hotel.

R. D. Gibbs, of the Union Oil Co. and president of the Association, opened the meeting by tracing its history, and telling of the work it has done toward the standardization of practices among all natural gasoline plant operations. He also stressed the cooperation of the association with various other associations in the oil industry, and mentioned that the work of the association has been so well done that many of the procedures developed have been adopted as standard by other gasoline plant operators.

After Mr. Gibbs' opening remarks, Col. Fred E. Foster, managing director of the California Oil and Gas Association, presented a brief plea for cooperation from the C. N. G. A. as an association, and as individuals, in the building up of public knowledge of true conditions facing the every-day operations of the oil industry. He told of the necessity for an active public opinion favoring the industry to stop inequitable legislation and taxation, and to make it possible for the industry to operate with just the necessary governmental regulation, rather than to have to cope with bureaucratic strangulation.

The morning business session was devoted to the presentation of committee reports by the various committee chairmen, following which N. C. Wells spoke on "Safety", Lyman Scheel delivered a paper on "Compressors", and Frank Burt presented another on "Liquefied Gas."

In the afternoon, Lieut. Colonel Oldfield, U. S. A., discussed possible military invasion of the United States, and concluded by saying that the greatest potential danger to this country lay in establishment of great military bases on the western coast of North America by the enemy, in time of war, from which they could ravage the coast cities by air, and from which military penetration and occupation by the infantry might be directed.

Fred E. Frey, chief chemist of Phillips Petroleum Co.'s research department, spoke on a subject which has aroused the keenest interest among the oil fraternity, "Polymerization." Another paper, entitled "Influence of Automobile Design on the Use of Natural Gasoline," written by C. C. Moore, Jr. and Dr. R. I. Stirton concluded the afternoon session.

Sidelights

Pete Fluor and Jim Reed literally "buttonholing" newly arrived members with their little identification tags.

■ ■

N. C. "Safety" Wells chiding the photographer for snapping him before he had time to organize a smile.

■ ■

G. N. Hile assuring the gathering that his Revisions to Bulletins Committee will continue to function 100% as long as no revisions are necessary.

■ ■

"Where WAS Fred?"

■ ■

"Swede" Olson's sweeping approach to the platform, and his entourage.

■ ■

The shy young thing who took her fans and went home when the lights changed color.

■ ■

Vince Barnett's obvious bewilderment when cold silence greeted his remarks on proration.

■ ■

Lawrence King's Irish songs stopping the show, and the vociferous demands for more of the same.

■ ■

Gilmore's MacFarland supplying his table with pumpkin pie which he obtained Lord knows where.

In the couple of hours intervening between the afternoon session and the banquet, members and guests were entertained by a sort of a "musicale and ice-cream social" which was held in the lobby immediately adjoining the meeting room. The banquet got under way at 7 p.m., right on schedule. Group singing, among other things was indulged in by the boys, with many old time songs the subject of mutilation. To add to the musical effect, the songs were sung in various tempos and keys, to the satisfaction of all present. The banquet room was packed, with attendance exceeding six hundred.

Gus Wetzel
Chairman, Entertainment Committee

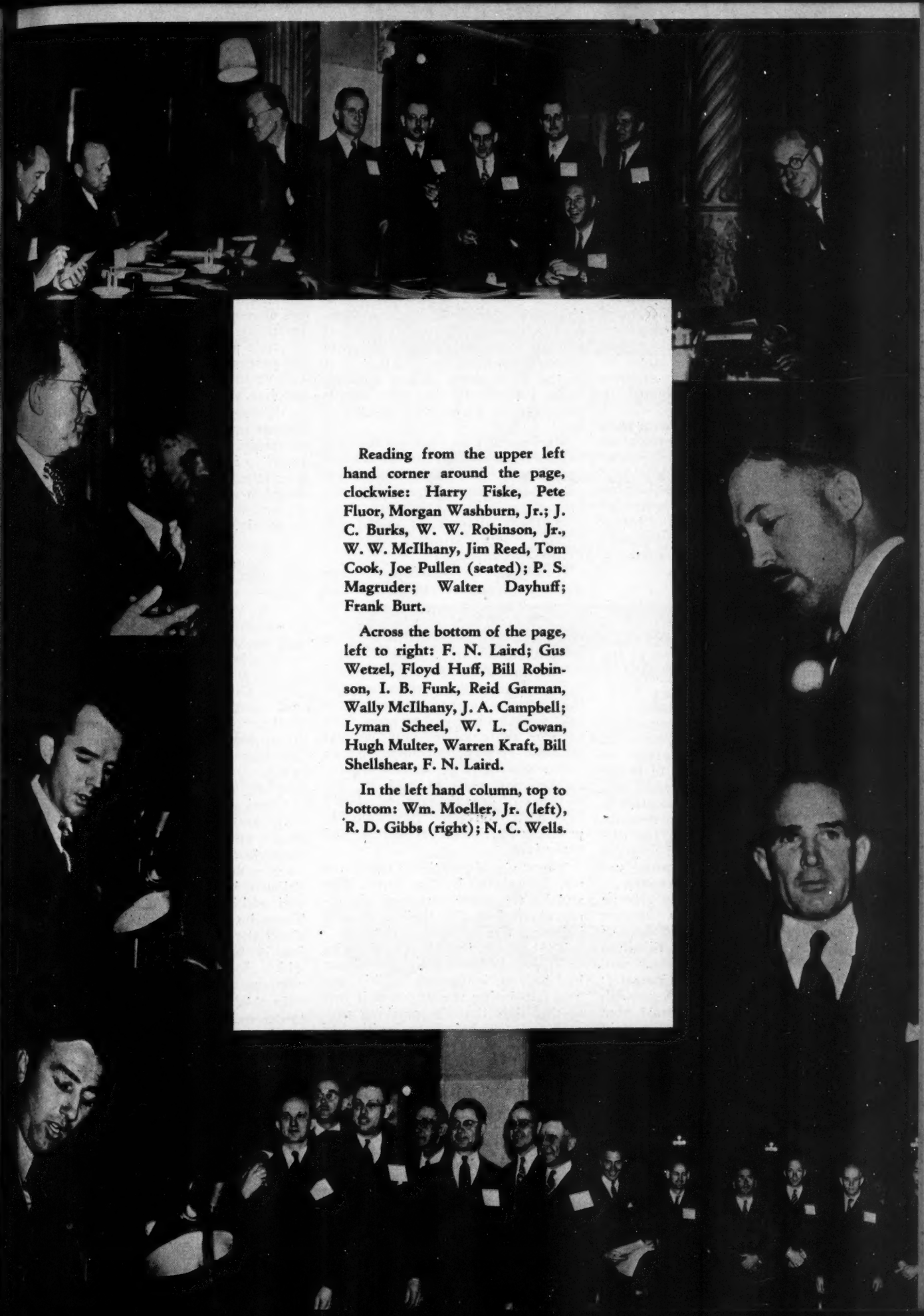
The banquet was followed by entertainment, headed by Vince Barnett, as master of ceremonies of a vaudeville show acclaimed as one of the best ever presented by a group of oil men. Gus Wetzel, chairman of the entertainment committee, has been receiving the congratulations of all those present for the masterful exhibition he and his committee put on.

■ ■ ■

Management Strengthened

The management of the Kern River Oilfields of California, Ltd., and The St. Helens Petroleum Co., Ltd., for many years in the hands of Charles Drader and R. W. Stephens, has been strengthened by the appointment of two additional members to the Management Committee, A. P. McEachern and Fred M. Ziegler.

Mr. Ziegler is a geologist and petroleum engineer and has served both companies in that capacity for various periods during the past fifteen years. Mr. McEachern, a member of the California Bar, has been Los Angeles secretary for both companies, in charge of purchasing, accounting and offices since 1924.



Reading from the upper left hand corner around the page, clockwise: Harry Fiske, Pete Fluor, Morgan Washburn, Jr.; J. C. Burks, W. W. Robinson, Jr., W. W. McIlhany, Jim Reed, Tom Cook, Joe Pullen (seated); P. S. Magruder; Walter Dayhuff; Frank Burt.

Across the bottom of the page, left to right: F. N. Laird; Gus Wetzel, Floyd Huff, Bill Robinson, I. B. Funk, Reid Garman, Wally McIlhany, J. A. Campbell; Lyman Scheel, W. L. Cowan, Hugh Multer, Warren Kraft, Bill Shellshear, F. N. Laird.

In the left hand column, top to bottom: Wm. Moeller, Jr. (left), R. D. Gibbs (right); N. C. Wells.

Utilization of Petroleum

By V. N. Ipatieff
Universal Oil Products, Co.

FOLLOWING THE HISTORY of the petroleum industry from its very beginning, nearly a hundred years ago, when the Dubinin Brothers [1] made their first attempts to distill kerosene from petroleum, it is possible to divide its development into distinct periods.

These periods were determined by the fuel market and by the applications of petroleum distillates in other branches of industry.

Petroleum quickly found a wide application in industry as a fuel. But since illuminating oils and high-boiling products such as lubricating oils were also desired, it became necessary to work out improved methods for the distillation of petroleum, leaving for fuel only the residues which could not be used for other purposes.

The Distillation Period.

The first period of the development of the petroleum industry can be called "the distillation period," and it lasted from the sixties of the last century to the beginning of the World War.

During this time the attention of the technologists was concentrated upon the fractional distillation of petroleum and the purification of distillates. The chemistry of petroleum was in an embryonic state, and the industry was not interested in it. The main objects were the production of petroleum and the discovery of its underground reserves —problems suited to engineers and geologists rather than chemists.

It may be worthwhile to give an example of the lack of interest shown by the leading oil men of Russia in a more rational utilization of petroleum. In 1911 I was consultant to Nobel Brothers Company; and I suggested, together with Gurwitsch, their chief chemist, that they study the cracking of certain petroleum fractions for which there was no demand. The executive board replied that they were willing to furnish the means for doing this research in my laboratory at the Artillery Academy, but that they did not see much practical value in the subject. Such an answer was justified from a commercial point of view, since oil companies at that time were making huge profits by merely selling "straight-run" distillates.

However, leading chemists began to be interested in the composition and origin of petroleum. Mendeleeff was the first to realize the tremendous importance of petroleum as a potential source of organic compounds. Knowing that geological investigations cannot give definite figures concerning the actual amount of the oil reserves in any locality, he gave a warning that petroleum is too valuable to be used chiefly as fuel.

Markovnikov was among the first to study the composition of various petroleums. He proved that Baku oil contains napththenes, i.e., hydrocarbons with a ring structure, which differed from the open-chain paraffin hydrocarbons found in Pennsylvania oil.

Numerous investigations made during this time in the United States, Russia, and other countries concerned themselves not with the chemistry of petroleum, but rather with its technology.

The reason for the lack of study in petroleum chemistry was mainly the chemical inertness of paraffinic and naphthenic hydrocarbons. The benzene hydrocarbons found in coal tar differ greatly from the petroleum hydrocarbons. The benzene hydrocarbons are reactive, and by the methods of organic synthesis could be readily converted into valuable products such as dyes, drugs, and explosives.

The study of petroleum chemistry was brought on by the World War and by the development of higher-power engines for the automobile industry, and later for aviation.

The production of gasoline by ordinary distillation of petroleum had become inadequate. This was first felt during the war, and it was at this time that the cracking process, i.e., thermal decomposition of petroleum was the purpose of increasing the proportion of low-boiling constituents at the expense of the high-boiling ones, received considerable attention in the United States.

The Cracking Period

In Russia, during the war, tremendous quantities were subjected to pyrolysis, and thousands of tons of aromatic hydrocarbons (benzene, toluene, and xylene) were produced for manufacture of explosives.

This period in the development of the petroleum industry can be called "the cracking period," because the cracking process in a short time found broad application in the United States and later in other countries. Present conditions of the petroleum market are such that it is profitable to crack a high percentage of crude petroleum, since the cracking process makes it possible to obtain up to 70 per cent yields of good gasoline.

Although, at first glance, the reactions involved in the thermal decomposition ("cracking" and "pyrolysis") of petroleum hydrocarbons may appear to be simple, in reality they are very complex—because numerous reactions take place simultaneously.

The development of the petroleum industry gave the impulse to scientific chemical research in this field. It had become necessary not only to determine the most favorable factors of time, temperature, and pressure for the cracking of various kinds of oil, but also to begin research on the actual reactions taking place in cracking. There are two dominating reactions in the cracking process: 1, decomposition of hydrocarbons into fragments and dehydrogenation; 2, re-combinations or secondary reactions. These two main reactions attracted the main attention of chemical thought.

In the laboratories of the United States, and to some extent in other countries, numerous investigations were made on the thermal decomposition of individual hydrocarbons of various kinds, particularly paraffins. These interesting investigations indicate the trend of thought of chemists in determining the manner in which hydrocarbon molecules decompose under high temperatures.

In this, research effort was made to determine the strength of various bonds between carbon and hydrogen and carbon to carbon in hydrocarbons of various structures, and to develop a "theory of the radicals" which would make it possible to predict from thermodynamic calculations the manner in which molecules of a given hydrocarbon would break at a given temperature.

The history of the oil industry by periods characterized by phases of demand. Paper presented at 1936 A. P. I. Meeting

It cannot be denied that abundant scientific material has been collected during recent years in connection with the study of the thermal decomposition of hydrocarbons which gives us valuable information, theoretical and practical, concerning the stability of various hydrocarbons. This also leads us to new ideas concerning the more rational utilization of petroleum hydrocarbons, so as to obtain from them hydrocarbons with more valuable properties and to convert them into other classes of organic compounds.

The Catalytic Period

Industrial organic chemistry, watching the development of the petroleum industry during its second or "cracking" period, soon took notice of the profits which could be made by utilizing the products of cracking as starting material for organic synthesis.

The first to be utilized were the olefins in cracked gases, which were converted into alcohols, ketones, etc.; but we now face the important question whether, under present conditions of the market and of other branches of chemical industry, we can stop at this stage of the development of petroleum products and with these methods which now are almost generally accepted.

My purpose is to answer this question, and to show that at the present time we are entering the third period of the development of the petroleum industry, which should be called "the catalytic period."

In order to show the necessity and usefulness of introducing new catalytic methods in the petroleum industry, I shall illustrate by an example from organic technology, which will immediately show you the advantages which could be obtained by substituting a delicate catalytic method for a rough thermal one.

Thirty-five years ago no one could explain why the pyrolysis of alcohols at 400-600 deg. C. yields various products such as hydrogen, carbon monoxide, aldehyde, methane, etc. The thermal decomposition of alcohols, especially ethyl and isoamyl alcohols, had been studied by many outstanding chemists for almost 100 years, but not one of them could explain in what way the decomposition took place and why such diverse products were obtained.

However, after the author had discovered that certain catalysts influence the decomposition of organic

(Continued on Page 26)

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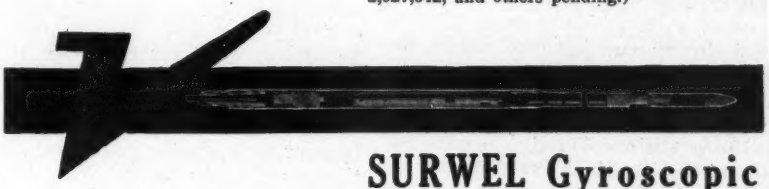
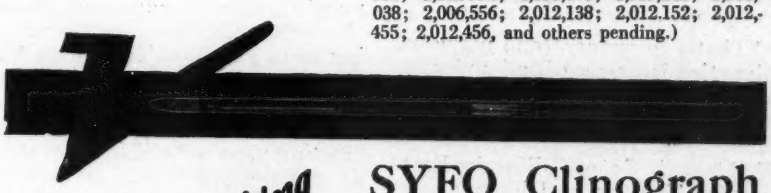


The Self Checking

SURWEL Gyroscopic Clinograph

The most accurate and reliable method ever devised for making underground surveys of bore holes, providing a true map of the course of the well at all depths, prepared from actual photographic records. Not affected by *Tortuosity* nor by *Magnetic influence* nor *human errors* when recording. Self-checking, makes two surveys in one round trip, one going in and one coming out. Speedy operation, requires less rig time than any other instrument. (U. S. Patents 1,124,068; 1,812,994; 1,898,473; 1,959,141; 1,960,038; 2,006,556; 2,012,138; 2,012,152; 2,012,455; 2,012,456, and others pending.)



The Self Checking

SYFO Clinograph

Records accurately on paper directly readable, the vertical deviation of a bore hole without the use of dangerous acids. Is speedy, self-checking, simple to operate and inexpensive. Can be used on a wire line or as a "Go-Devil" running inside the drill stem or on sand or bailing line in open hole. (U. S. Patents 1,962,634; 2,013,875, and others pending.)

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Court Hands Down Decision In Oil Well Survey Orienting Devices And Methods

FINDINGS and a decree were handed down by Judge Paul J. McCormick in the District Court of the United States for the Southern District of California, Central Division, on Oct. 21, last in a suit for infringement of patents filed by Alexander Anderson, Inc., against Eastman Oil Well Survey Co. of California, Eastman Oil Tool Co., Eastman Instrument Co. and H. John Eastman, Equity No. 735-M (Consolidated Cause.)

In his findings, the Judge stated "It is comparatively easy, now that the Anderson methods and apparatus are in evidence, to take this and that from the references and achieve a **nunc pro tunc** solution of the problem confronting Anderson when he made his invention. This cannot be done to defeat an invention that has marked a valuable forward step in an industry such as the Anderson patent has done.

"Patent No. 1,770,224 is a pioneer and generic invention and as such includes Claims 4 and 6 of Patent No. 1,830,345, which last mentioned claims of said later patent do not constitute additional invention."

Injunction Issued

The decree states "That the plaintiff, Alexander Anderson, Inc., in both of the above consolidated cases is now and at the times alleged in the bill of complaint herein was the owner of the entire right, title and interest in and to each and every of said Letters Patent in suit herein, and the inventions covered thereby - - - - ."

"That a permanent and perpetual injunction issue out of and under the seal of this Court, restraining and enjoining the above named defendants H. John Eastman, Eastman Oil Well Survey Co. of California, Eastman Oil Tool Co. and Eastman Instrument Co. and each thereof, and their respective officers, directors, attorneys, agents, servants, employees, assistants, associates, confederates, workmen and those in active concert or participating with them or any of them, from directly or indirectly manufacturing or causing to be manufactured, using or causing to be used, vending or causing to be vended, offering for sale, selling or causing to be sold, leasing or causing to be leased, renting or causing to be rented, or advertising for sale or use, any bore-hole directional apparatus or methods of orientation like those described in the 'Conclusions of the Court'."

The decree then describes infringing methods used and practiced by the defendant as early as Feb. 26, 1933, and quotes the testimony of a witness. The decree also refers to photographs of infringing devices used by the Eastman company which included a telescope used in the derrick and a transit mounted on the drill pipe by means of a "C" clamp.

The defendants are enjoined from infringing Claims Nos. 1, 2, 3, 4, 5, 6, 8, 12, 13, 14 or 18 of United States Letters Patent No. 1,770,224. Among these claims:

No. 3 reads—

"In a method of determining the orientation of a device that is moved within and longitudinally of a borehole to different points along the length thereof, the steps comprising initially determining the rotational relation of the device with respect to a chosen plane of direction, moving the device along within and longitudinally of the bore in stages, and measuring the extent and direction of rotation of the device that occurs during each such stage of its movement."

Claim No. 14 reads—

"A sighting device for use in determining the orientation of a line of pipe in a bore-hole which comprises in combination, a sighting member, means for supporting said member on said pipe for rotation about the axis thereof and for sighting upon a fixed object distant from the pipe, means for holding said member against such rotation, and means for measuring rotation of said sighting member with respect to the axis of the pipe."

Claim No. 18 reads—

"The method of orienting a device that is moved along a borehole attached to a line of pipe and which device is moved by movement of the pipe in stages, the steps comprising fixing a sighting member on the pipe in such relative position thereto that the line of sight is in a chosen plane of direction."

The decree continues "That the defendants furnish the plaintiff with an account of profits accrued to the defendants, and each of them, resulting from said infringements; that an account of plaintiff's damages resulting from said infringements be taken and stated, and that plaintiff have judgement for the damages and profits so found."

Anderson Starts Cholame Wildcat

AMIL A. ANDERSON, California, Mid-Continent and Rocky Mountain geologist, now a resident of Los Angeles, is starting a new wildcat on sec. 15, 24-14, Cholame Hills. The derrick has been built and was rigging up over the week end.

Mr. Anderson has been interesting himself in the prospects of the Cholame Hills for the past five or six years. He has traced out an anticlinal fold with three closed areas, the whole 15 miles in length, starting at the south end with a width of about two miles and widening to about five miles across at the north. The south end is near the Cholame postoffice, sec. 30, 25-16, at the west edge of the unsurveyed Rancho Cholame, and runs northwest across two townships to end near the northwest corner of township 24-14.

About seven miles southeast, on sec. 10, 25-15, the Cholame Syndicate is down to 3687 ft., and reports oil sands and shale. They have not yet been tested. Mr. Anderson hopes for commercial oil somewhere between 3300 and 3600 ft. No other wells have been drilled on the structure to any depth great enough to show anything, although an old map shows a 1600-ft. well to have been drilled by the Baker Oil Co. on sec. 16, immediately adjoining sec. 15 where Mr. Anderson's drill site is located.

Starting in San Luis Obispo near the Bakersfield-Paso Robles highway, the Cholame anticline ends in the southeast of Monterey county from three to five miles west of Parkfield. Mr. Anderson's location is some three miles west of Parkfield. However, there is no connection whatever between the Parkfield area where so many unsuccessful wildcats have been drilled and the Cholame anticline, unless it be found that the small amounts of oil found around Parkfield are seepages from the big structure.

Mr. Anderson has started his well under his own name. Jack Jehl is his superintendent.

■ ■ ■

Standard Down 3000 Ft.

Spudded in Nov. 1, Standard Oil's McDonald Island No. 2, sec. 19, 2n-5e, San Joaquin county, has passed the 3000-ft. level. Eleven-inch surface casing was set at 530 ft.

Well, peepul, the biggest C.N.G.A. annual fall meeting ever held was carried successfully through from beginning to end, without the slightest hitch. Under the capable arrangement of Bill Moeller, events followed each other as smoothly as the little ripples on the river Afton. In fact, only one trifling mishap marred an otherwise perfect record. Poor Lyman Scheel stepped back to take a bow, after presenting his paper, and fell off the rear end of the platform. 'Stoo bad! That was the only drop Lyman had all day.

■ ■

Our information is to the effect that the affair was also a financial success, due largely to the high pressure salesmanship of Pete Fluor, who sold about 200 registration cards, under the mistaken impression that they were tickets for the banquet.

■ ■

He even volunteered to sign up the two ukelele girls for membership in the C.N.G.A., if they could produce enough plunks.

■ ■

Bill Ackerman was there as large as life representing San Francisco, and of course to continue his anatomical studies. Bill can't understand why the technical committees keep on dallying around with fractional analyses, when they might just as well be doing the whole thing.

■ ■

There is no question at all that these technical conventions are highly instructive, and really worthwhile. As Bob Crippen aptly stated it to a group of newspaper men, "It's things like this that make the world go 'round—with a worried expression."

■ ■

Wally McIlhany reports that one gasoline plant operator apologized for not being present, and explained that he had been out shopping with his wife, and lost his balance.

■ ■

Then there was the delegate who confessed that he had become a gasoline man by absorption.

■ ■

And leaving the annual fall meeting for the moment, we would like to inform our readers that Howard Robinson is an enthusiastic member of the Brea Lions Club, which explains why, every time you call him on the phone, the operator announces, "The Lion's busy".

■ ■

Personally we can never understand how clubs of this sort are able to continue in business, with so any lions to eat up the prophets.

■ ■

We have discovered also that the oil man who was seen running his automobile back and forth in front of a hospital all day last Tuesday was merely a safety supervisor teaching his wife to drive.

■ ■

And according to Shorty Helms, a superintendent is a large forceful person of few words, but often.

■ ■

Another one of these economists has been trying to get us all excited recently with a prediction that the supply of gasoline will be completely exhausted by the year 2000. Roy Gibbs, however, declares there is no cause for alarm. By that time there will be so many automobiles they won't be able to move anyhow, so what's the use of worrying.

■ ■

All of which merely goes to show that the traffic is not nearly so dense as the drivers.

■ ■

And Eddie Phelps says what some people don't know about driving would fill a boulevard.

■ ■

"What did the boss say, when you asked for that increase?", asked the rousty, and his educated buddy replied, "He acquiesced". Whereupon the rousty spat disgustedly and remarked, "He did, eh? The dirty so and so!"

■ ■

And we are told that it takes all four of them standing in a row to demonstrate the size of the first fish they caught.

■ ■

But then you can't tell about these things. Maybe a fish goes home and lies about the bait he stole.

■ ■

With which few remarks, we're going home ourselves. Remember the great secrets of success are money, money and money.—R. S.

When you run in a BAKER ROTARY WALL SCRAPER and start the pumps, the blades open positively and scrape away rotary mud from the face of the oil sand . . . or enlarge the hole for setting larger casing or liners . . . or for placing more cement against the formation to secure a perfect water shut-off . . .

. . . and when you stop the pumps, the blades of the Baker Wall Scraper close downward into the body and the tool comes safely out of the hole.

You can profitably use a

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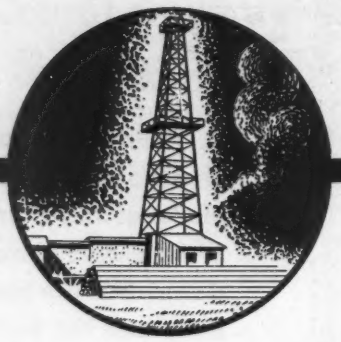
Hydraulic Expansion
WALL SCRAPER



Production

Mascot Considering Up To 4000-Ft. Test Of Lease In Midway District

MASCOT OIL CO.'S directors have under consideration the drilling of a test to somewhere between 2800 and 4000 ft. on the company's 160-acre lease on the ne¼ sec. 26, 32-23, Midway, 1½ miles southwest of Taft. Action was postponed until the next meeting which will be held Dec. 6, when a decision will be reached.

One of the oldest companies in the state, Mascot has more than 50 wells, their average depth about 1200 ft. The location is looked upon as one of the most favorable in the field for a deeper sand. The shallow wells, now more than 30 years old, produce in paying quantities with limited attention. The oil is 15 gravity. The land is owned by Mount Diablo Oil Co.

Some five years ago, Standard Oil subleased from Mascot the right to drill a deep test and the exclusive right to develop any deep sand found. The well was drilled to a total depth of 9300 ft. It logged oil and gas showings from 2800 ft. to 4000, with streaks of sand and shale intermingled at several points, the shale and sand cutting oil, and at times the ditch was bubbling. Again strong oil and gas signs appeared from 6000 ft. down to about 6500. Gas pressure built up quite strong and heavy mud and weight material were pumped in under pressure to hold it in check.

Later, the Standard Oil Bulletin spoke of the well as having been drilled for geological information, which was undoubtedly one of the prime motives as the time was not good for bringing in a new field. The result was undoubtedly a mass of invaluable data on the strength of which the Mascot now plans to drill to the first sand logged below the shallow bottom of its old wells.

Standard finally bottomed the well at 9300 ft., and all accounts agree that it had everything to indicate a successful producer at this point. But the time was far from propitious for bringing in what looked much like the equivalent of a new big field so it was agreed between the Standard and the Mascot that the well should be capped for a year. When the year expired the agreement to let it stand was extended for another year. Then the Mascot directors decided they wanted to see what they had, so Standard went back into the hole.

Terrific Heat Wrecked Well

Never before had any well of that depth stood idle and capped for any extended period; indeed, the number of wells drilled to such depths could be counted on the fingers, so that nobody knew what the effect would be. When the well was drilling and before it was finally capped the pressure was about 2000 pounds and the gas forced the mud, oil and water up to within 2000 ft. of the top. When the drillers reopened they found a temperature of some 200 degrees at the bttom, the pressure was gone, could never be restored, and the well had to be abandoned as a failure to the astonishment and disappointment of Standard and Mascot alike. Such terrific heat appears to have been the cause of the trouble and has had similar effects in several other deep wells since then.

Thus, from all accounts, no final tests were made of the 9300-ft. well's possibilities which, from available reports, appeared to be excellent. The failure was nobody's fault, for the well was carried so deep for exploratory purposes and in the hope of getting bigger production and nobody expected what followed the mistake of letting the well stand capped so long.

Now Mascot will likely test the formation and its possibilities from about 3000 to 4000 ft. Later it may go to 6000 and test the possibilities logged there. Success may be expected to start a substantial drilling campaign on sec. 26 and adjoining sections.

The well site has not been selected but it is expected to be close to the Standard's deep hole now abandoned and plugged. Standard quitclaimed its sublease to Mascot.

■ ■ ■

Surf Oil Redrills Four Wells

Surf Oil Co., recently organized and headed by Roland Tognazzini, of San Francisco, is preparing to go back into four old wells on the Southern Pacific right-of-way adjacent to Seacliff, Ventura county.

Originally drilled by the Standard Oil Co. in 1928, the wells were producers up until several years ago. Due to sand encroachments, very little oil has been produced from them in recent years. Surf Oil will deepen all four projects approximately 600 ft. to improve their flow. Southern Pacific No. 4 will be gone back into this week, with work to follow in S. P. No. 1, No. 2 and No. 5, respectively. Floyd Preston, superintendent, will be in charge of field operations.

In addition to Mr. Tognazzini, who maintains company offices in the North, Surf Oil development work will be handled from its Los Angeles offices by Roy G. Steele, vice-president, and R. A. Perkey, secretary-treasurer.

■ ■ ■

Gato Ridge Test Planned

Benjamin A. Moyle of Long Beach and associates will drill within 30 days on a 31-acre lease on sec. 4, 8-32, Gato Ridge. This is the fifth new well known to be contemplated in this district in the immediate future.

Shell Oil Makes Third 10 Sections Location

SHELL HAS MADE a location for its third well in the 10 Sections field, its Ke. C. L. No. 34, 2310 ft. south and 1650 ft. east of the northwest corner of sec. 29, 30-26. This will make three wells on the discovery section. Shell's second and latest producer has been gradually beaned down until it is below 1000 bbls. per day to make it conform to its quota.

Lack of oil developments in the Standard and Ohio wells begins to make it look as if the Shell geologists may have succeeded in getting all the good oil lands on the structure as they maintain they did. Standard is drilling at 8300 ft., below the Shell depth, still has nothing but a few stringers of oil sand, and is now in hard brown shale. This refers to its KCL No. 10-1, sec. 20, 30-26, immediately north of the Shell wells. On sec. 34, just southeast of Shell, Standard's KCL No. 9-1 is drilling in hard gray shale at about 7720, with no signs of oil at last reports. Ohio, on sec. 19, 30-26, immediately northwest of Shell's wells, was in gray sand at the last report with no signs of oil. The gray sand was topped at 8260, after one foot of oil sand had been cored a little higher. No other sign of oil has been developed.

Wilmington Wells To Start

New wells are to be started at Wilmington by the Petroleum Marketing Corp. at Blinn Ave. and East N; by the Selegna Drilling Corp. at Colon and N, tract 1746; by the Twin Harbor Drilling Co., the Sovereign Oil Co. and the Sunset Oil Co. on the Lupie lease, formerly the Pacific Investment Co. Gauthier Oil Co. is drilling below 3200 ft.

■ ■ ■

Bestco Drills At Fillmore

Bestco Petroleum Corp., subsidiary of the newly organized Surf Oil Co. is drilling a wildcat, Frey No. 1, sec. 2, 3-19, in the Fillmore district, which is down to approximately 4550 ft. This project has cored 35 ft. of oil sand but is expected to go considerably deeper to determine what the lower formation may develop in the way of commercial production.

Interest in the Fillmore district is mainly due to several wells being drilled there by Union and Associated. General Petroleum, Petroleum Securities, Bankline, and Texaco also hold acreage.

Union Down 8125 Ft.

Union Oil Co. has reached a depth of 8125 ft. in Chapman No. 29, its deep test of the Richfield district. The drill is now some 2000 ft. below the bottom of the next deepest well in Richfield. Union will give out no information about its findings.

West Coast Refining Co., sec. 25, 3-9, is down 2050 ft. The location is at the edge of Santa Ana Canyon and of the Kraemer area. Formation reported is shale. Thirteen inch surface casing was set at 182 ft.

Standard Oil will redrill and deepen its Kraemer No. 2-11.

At Placentia, the extreme opposite side of the Richfield field, the California's Eastern's Verde No. 1 is being redrilled from 4100 ft.

■ ■ ■

H. B. Extension Abandoned

Quitclaiming of the Anaheim Sugar Co.'s land east of Huntington Beach by both the Shell Oil Co. as operator and Ralph B. Lloyd as original lessee after one test well had been drilled and abandoned, has blasted high hopes of an extension of Huntington Beach eastward perhaps to Newport.

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Signs Point To Drilling Revival In Northern Sacramento Valley

SOME SIGNS point to a revival of drilling in the northern Sacramento Valley about Jan. 1 or a little later, although at present the only work actually in progress in Tehama and Glenn counties is at the Tehama Petroleum's Materson No. 1, sec. 4, 22n-5w, west of Orlando. Here the hole has been redrilled and cleaned out to 3034 ft. Two small oil sands were found around 2300, and there was heavy gas between 1750 and 2450 ft. Acid is being used to remove mud from the formation and open the gas. If enough gas can be obtained it may be used as fuel to drill a new well.

Tehama Petroleum is now in the hands of E. S. Stella as trustee and he is bending his efforts to its revival in the hope of recovering the money of the stockholders. He believes there is a chance to get both oil and gas if a new well can be drilled.

Orland Oil Syndicate

East of the Masterson well and between it and the city of Orlando, on sec. 31, 23n-3w., is the Johnson well drilled by the Orland Syndicate some six years ago to 3800 ft., where it has been standing ever since, the hole badly junked, but with great quantities of gas pouring from its partially open mouth. The gas is declared to smell of oil, but has not been analyzed.

Louis Chasseur organized the Orland Syndicate in Los Angeles, a group of Santa Fe railroad employees holding control. T. K. Ware, then with the Santa Fe, but now operator of a market at Gardena, is secretary and has had negotiations with different operators over a long period in the hope of getting some one to clean out the hole and see if it can be made commercially productive of either gas or oil. Last year the report was abroad that a Mr. Leonard from the Mid-Continent had undertaken this work. However, that report proved to be premature, for the negotiations failed, and the well is still standing and blowing gas daily. A watchman remains at the well and Mr. Chasseur stays at Orlands to look out for the syndicate's interest. Mr. Ware hopes to get some one to take hold soon. If not, the syndicate itself may try again.

Wm. C. Warfield, who headed the North Counties Oil Co., which drilled the 8253-ft. Ewers-Mooney well, a little way outside the city of Corning, is working on plans to drill another well close by to test the zone from 3600 to 4390, where reports agree that there were strong signs of oil and gas in varying quantities. It is stated that the paleontological and geological reports of Jerry Harriss, the resident geologist employed by the company, were favorable. Mr. Harriss is now with Standard Oil in Arabia. Some weeks ago, Mr. Warfield had a conference with a meeting of 40 citizens of Corning to discuss the prospects for a new well.

That a mistake was made in not testing this zone is generally admitted, but still better was hoped for below and the drilling went on to explore the lower formations. At 4390 the drill went through seven feet of shell cap and at 4397 encountered salt water. It could not be shut off so no test was then possible and drilling was continued to the present bottom.

At the meeting in Corning, Mr. Warfield was quoted by the local daily paper as stating that a new well ought to be drilled at a cost not exceeding some $30,000, that no coring will be necessary as the company has a complete picture of the underground formations in the log of No. 1, and that to deepen No. 1 would require a new string of casing costing about $40,000. The site for a new well has been tentatively chosen 2640 ft. southwest of No. 1.

Harold Green, geologist and engineer, who originally located the well and had charge of drilling operations, is no longer connected with the company, it is learned. He is now practicing his profession with offices in Los Angeles and San Francisco.

Among geologists, engineers and operators, the Warfield well was generally looked upon more favorably than any other yet drilled in the Sacramento Valley. The anticline has been declared to be plainly defined. It has been commonly supposed that some of the larger companies with land holdings in that area contributed to the expense of drilling the well, although this has not been verified.

Los Chicos Oil Co.

Los Chicos Oil Co., headed by A. H. Goodale and Comly Shoemaker of Los Angeles, has a derrick up for its first well, Scharr No. 1, on sec. 27, 25n-4w, Tehama county, north of Corning. No date has been yet set for starting work. Some years ago, Mr. Goodale and a Los Angeles group drilled near Flournoy, west of Corning, finding considerable gas, but not in commercial quantities.

Other Operations

Another derrick has been erected near the Los Chicos well by the Midway Valley Oil Co., with headquarters in Sacramento. No further move has yet been made to go ahead with this well.

Tehama Leaseholders, a company headed by one Jack Nash, has assembled 7500 acres in a solid block a little north of the Los Chicos and Miway Valley holdings. Details of the ownership or plans of this company have not been obtainable.

Advices are that Coast Exploration Co. of San Francisco has some large acreage in this area. There is nothing to indicate any early intention on its part of drilling there.

Tannehill Oil Co.'s well in Colusa county, just over the Sutter line, is standing idle at 2500 ft. The Tannehill brothers, who constitute the company, or most of it, say they found substantial evidence of the presence of oil and gas. They still hold their leases and may drill again early next year.

■ ■ ■

Waiter: "Do you want your eggs turned over, sir?"

Fred Gilmore: "Yes, turn them over to the Museum of Natural History."

Chiksan
HEAVY DUTY
REAMER
The reversible shaft, and extra long Herringbone milled rollet featured only by Chiksan, gives the most economical and safest reaming service. Extra large diameter shaft reduces wear between roller and shaft. The large circulation hole through the body enables wire line core barrels to be run through the reamer.
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GULF ENGINEERS INC.
HOUSTON, TEXAS

• California • Production

AVERAGE PRODUCTION
October 31, 1936 to November 6, 1936, Inclusive

	November Quota	Barrels Production
San Joaquin Valley		
Belridge—North	10,560	13,256
Belridge—South	1,975	1,840
Buena Vista	16,770	17,393
Coalinga—East	11,725	9,004
Coalinga—West	5,350	5,483
Coffee Canyon	4,700	4,698
Edison	5,320	5,794
Elk Hills	8,160	8,000
Fruitvale	7,795	9,087
Kern Front	9,780	10,615
Kern River	3,380	2,334
Kettleman Middle Dome	375	289
Kettleman North Dome	77,150	79,025
Lake View	3,015	10,443
Lost Hills	4,255	4,005
McKittrick	3,680	1,691
Midway-Maricopa	32,395	36,559
Mount Poso	15,555	16,542
Mountain View	21,870	21,678
Poso Creek	1,715	1,828
Round Mountain	6,860	7,623
Ten Section	695	1,697
Wheeler Ridge	340	329
Others	.....	.....
TOTAL	253,420	269,213
Coastal District		
Capitan	1,705	1,455
Elwood	10,810	11,744
Padre Canyon	345	376
Rincon	1,860	2,350
San Miguelito	1,155	1,834
Santa Barbara	1,090	1,051
Santa Maria	4,850	4,904
Santa Paula-Newhall	4,250	5,014
Ventura Avenue	29,205	33,419
Others	310	290
TOTAL	55,580	62,437
Los Angeles Basin		
Alamitos Heights	1,510	1,809
Brea-Olinda	7,950	8,261
Coyote—East	2,280	2,418
Coyote—West	7,855	7,597
Dominguez	22,380	25,004
El Segundo	310	357
Huntington Beach—New	18,560	21,711
Huntington Beach—Old	13,465	15,243
Inglewood	12,255	11,999
Lawndale	80	86
Long Beach	60,030	65,796
Los Angeles	645	712
Montebello	5,925	5,920
Montebello Extension	2,095	3,726
Playa Del Rey	11,495	11,540
Potrero	290	277
Richfield	6,800	7,527
Rosecrans-Athens	1,965	2,287
Santa Fe Springs	41,135	45,377
Seal Beach	7,355	7,366
Torrance-Hermosa	5,565	6,362
Torrance Extension	1,835	1,998
Whittier	995	947
Others	530	423
TOTAL	233,305	254,743
STATE TOTAL	544,000	586,393

■ ■ ■

Tracy Land Reported Leased

An unidentified major oil company has been reported to be leasing lands in the Tracy gas area, lying to the east of Seaboard's unsuccessful operations.

Terminal No. 1 Struggles With Drilling Water

GENERAL PETROLEUM'S Terminal No. 1 is still struggling with the difficult problem of getting rid of drilling mud and water. Bailing is now underway. On the pump, the well has definitely established the existence of 27 gravity oil from 5285 to 5495 ft. Pumping production averaged close to 15 bbls. per hour, with a cut running from 24% to 60%, showing the absolute necessity for getting the hole much more thoroughly cleaned out before any commercial operation will be possible. After three days of pumping, the well was taken off the pump and bailing started.

Meanwhile, General Petroleum is drilling straight ahead on its Patton No. 1, which was down 2100 ft. Tuesday. It is understood that it will be drilled to the third zone where Terminal No. 1 is now bottomed.

Gauthier Oil Co. has bottomed at 3695, set casing 100 ft. higher and will make a test for production this week. Showings have been reported as good.

Bankline Output Down

Bankline's output from its Community No. 1 has fallen to about 50 bbls. per day, 16 gravity. This well went to 4400 ft., which is about 1000 ft. less than the G. P. Terminal No. 1, and then backed up to 3510, from which point it is producing on the pump.

Inquiry of the company brings the statement that there are no plans to deepen the well and nothing is expected to be done along that line, although another well may be drilled later on for a deeper test. Whether or not Bankline is on the same structure as the Terminal well is still undetermined in the opinion of its field staff although the logs of the two wells check fairly close.

Selegna Oil Co. has a derrick up near the crossing of N Street and the Southern Pacific tracks.

■ ■ ■

Bill Abrams, attorney for the Mining Bureau, astonished his friends at a party held last Saturday evening by announcing his marriage on the previous day. Most of the guests had believed the party to be in celebration of California's victory over Southern California and were considerably surprised to learn that another confirmed bachelor had at last struck his colors. Congratulations, Bill.

Drilling Report

Coyote Hills — **NEW WELLS**
Bartholomae Oil Corp.
Stern ..... 4 22 3 S 10 W
Ventura
Continental Oil Co.
Casitas ..... 1 7 3 N 23 W
Santa Barbara County
Union Oil Co.
Vincent ..... 1 25 10 N 34 W
Associated Oil Co.
Edwards Estate ..... 1 2 4 N 30 W
Capitan
General Petroleum Corp.
Erburu ..... 21 32 5 N 30 W
Midway
R. McGray ..... 1 22 32 S 23 E
Sunset
Five Points Petroleum Corp.
Lease Two ..... 2 18 11 N 23 W
Poso Creek
Honolulu Oil Corp., Ltd.
69 ..... 8 28 S 27 E
Kern River
American Exploration Co.
Cauley ..... 2 16 28 S 27 E
National Oil Co.
Grau ..... 5 11 28 S 27 E
Fruitvale
Western Gulf Oil Co.
23-KCL-B ..... 22 29 S 27 E
Brockman ..... 1 21 29 S 27 E
Kern County
British-American, Inc.
Smith ..... 1-A 21 31 S 27 E
San Joaquin County
Standard Oil Co.
McDonald Island Farms ..... 2 19 2 N 5 E
Solano County
Amerada Petroleum Corp.
M. Hamilton ..... 1 26 4 N 2 E
Kettleman North Dome
Standard Oil Co. ..... 85 19 21 S 17 E

DEEPEN OR REDRILL

Long Beach
W. O. Dye & Associates ..... 6 20 4 S 12 W
Coyote Hills
The Petroleum Co.
Gilman ..... 1 24 3 S 10 W
Graham-Loftus Oil Corp. ..... 20 18 3 S 9 W
Huntington Beach
Richfield Oil Co.
Fidelity ..... 10 2 6 S 11 W
The Petroleum Co.
Wilson ..... 1 2 6 S 11 W
Heckes & Pierce
Stone ..... 1 10 6 S 11 W
Ventura
Shell Oil Co.
Edison ..... 26 28 3 N 23 W
Midway
General Petroleum Corp.
Balboa ..... 53 24 31 S 23 E
Kern River
Italo Petroleum Corp.
Cauley ..... 32 16 28 S 27 E
Coalinga
J. C. Ferguson
Guthrey ..... 4 31 19 S 15 E
The Netherlands Oil Co. ..... 2 26 20 S 14 E
Mt. Poso
Petroleum Securities Co.
Gardner ..... 5 26 27 S 28 E

ABANDON

Long Beach
D. D. Dunlap ..... 3 30 4 S 12 W
Affiliated Oil Producers, Inc.
Randall ..... 1 30 4 S 12 W
Simi
Paloma Oil Co.
Paloma Marr ..... 1 12 2 N 18 W
Conejo
Fulkerson Oil Co. ..... 1 33 2 N 20 W
Arroyo Grande
Crail Bros., Inc., Ltd.
Vetter ..... 1 8 32 S 13 E
Santa Barbara County
The Texas Co.
Rutherford ..... 1 - 4 N 30 W
Belridge
Shell Oil Co.
Voigt Three ..... 1 5 28 S 20 E
Kern County
K. C. Wallace
Harris ..... 1 35 11 N 23 W
The Texas Co.
Kern County Land Co. C-11-49 11 11 N 22 W
Sunset
Gibson Oil Co., Inc.
Blanck ..... 1 6 11 N 23 W
Lost Hills
Lincoln Petroleum Co.
Theta ..... 1 12 26 S 20 E
Mt. Poso
Buchner Bros. ..... 1 22 26 S 28 E
Mountain View
Associated Oil Co.
DiGiorgio ..... 2 3 31 S 29 E
Kettleman North Dome
Standard Oil Co. ..... 87 13 22 S 17 E

Auto Design Effect On Natural Gasoline

(Continued from Page 11)

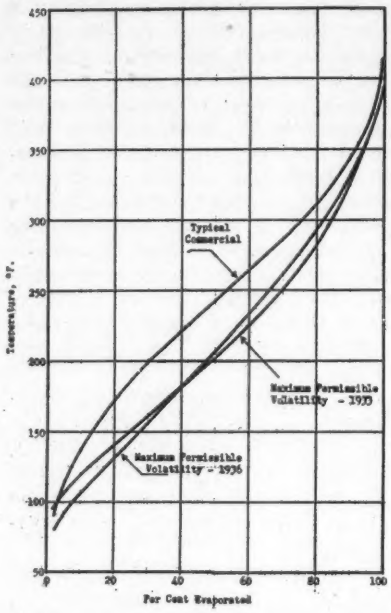
tioned in passing that the progress noted in this direction is probably a by-product of the use of higher compression pressures in the newer engines. The higher compression pressures have necessitated raising the antiknock quality of the fuels supplied for these engines. One of the most satisfactory methods of increasing the knock rating of a gasoline is to incorporate in it larger quantities of natural gasoline. The result has been that as the octane number requirements of the new automobiles increased, the volatility of marketed fuels has also increased and the automotive engineers have been forced to take steps to decrease the vapor locking tendency of the cars. As yet, the actual mechanism of these modifications and the effect on the gasoline actually entering the motor has not been considered. This is of some interest, and may well be considered at this time.

Two Solutions

The problem concerned in preventing vapor lock is susceptible of two solutions; either the gasoline may be kept cool in the fuel system so that no vapor handling problem arises, or the gasoline may be allowed to become heated and arrangements made to dispose of the vapor formed. While much has been done by the automotive engineers along both of these lines of attack in recent years, all their modifications leading toward lower fuel line temperatures have been nullified by the

FIGURE 3

ENGLER DISTILLATION CURVES OF WINTER GASOLINES



art departments. Consequently, all significant progress which has been made has been in the direction of increasing the vapor handling capacity. The gasoline reaches the same temperatures in the 1935 and 1936 cars as it did in the cars of 1930 and earlier, and the vapor formed is disposed of in the most simple available manner, namely, by venting to the atmosphere. Consequently, the improvement in vapor locking characteristics of the later cars has been accomplished at the expense of potential economy. It is an extremely difficult problem to determine experimentally the actual percentage loss of gasoline in this manner in an automobile under actual operating conditions, but it has been estimated by various investigators at from 5% to 20%.

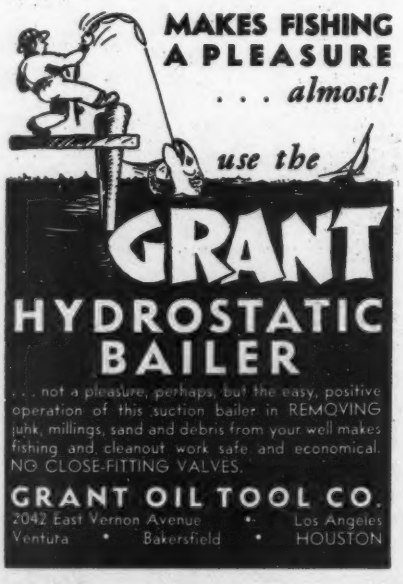
Laboratory Apparatus

The apparatus shown diagramatically in Figure 4 was set up in the laboratory as an approximation of the fuel system of a modern car. The gasoline is withdrawn from the storage container "A", and is pumped by fuel pump "B" through a primary heater "C", which is simply a copper coil immersed in a hot water bath. From here the heated gasoline flows to a secondary heater or "carburetor float bowl", "D", in which the liquid level is maintained by overflow through the side neck and the vapors are vented at essentially atmospheric pressure and carried off through a vacuum hood. The overflowing liquid gasoline is cooled by passing through an ice-water condenser, "F", and is collected in the receiver, "G".

Gasolines were pumped through this system at the rate of 125 ml. per minute, which corresponds to approximately the rate of flow of gasoline in an automobile running 40 m.p.h. and consuming gasoline at the rate of 20 miles per gallon. The four gasolines previously described, which had been prepared to meet the "front end" volatility specifications established by the cars on the road in 1933 and 1936, were run through this apparatus at the temperature and with the results shown in Table 1.

Carburetor "Bottoms"

These temperatures and conditions are not far removed from those which may be encountered in the automobiles of today, and may be considered to indicate that, if the petroleum industry chose to furnish gasolines as volatile as these cars can handle satisfactorily, the public would only be able to get 80 to 90 cents of its dollar's worth of gasoline into the cylinders. Furthermore, the fuel which actually passed the carburetor in such an engine would differ a great deal from the gasoline purchased. It would have lost in large measure the highly volatile "front end" portions which contribute to easy starting, rapid warm-up, decreased detonation, and rapid acceleration. To illustrate the rather startling differences between the original gasoline and the "bot-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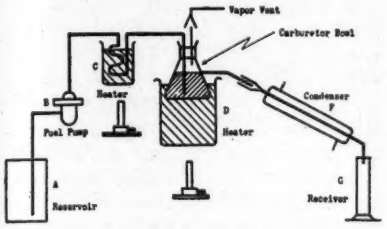
toms" passing the carburetor, Figure 5 has been plotted, showing the Engler distillation curves of the original summer gasolines and the "carburetor bottoms" actually passing the carburetor. As regards the effect of this "topping" process on the knock rating of the "bottoms" passed to the engine, it may be mentioned that the knock rating of the

FIGURE 4

A LABORATORY APPROXIMATION OF AN AUTOMOBILE FUEL SUPPLY SYSTEM



original blend of highly volatile Summer 1936 gasoline was 72 octane number. After passing through the laboratory apparatus, the overflowing liquid or "carburetor bottoms" showed a knock rating of 70 octane number. Similarly, the laboratory blend representing permissible Winter 1933 gasoline showed a decrease in knock rating from 72.5 to 71.5 octane number. Consideration of these data certainly lead to the conclusion that the customer would suffer appreciable loss in both quantity and quality if gasoline producers worked up to the permissible limits. We do not care to present at this time results obtained with this apparatus on commercial gasolines now being marketed. Suffice it to say that the typical gasolines now marketed in this area are not subject to more than half the losses which these highly volatile gasolines show.

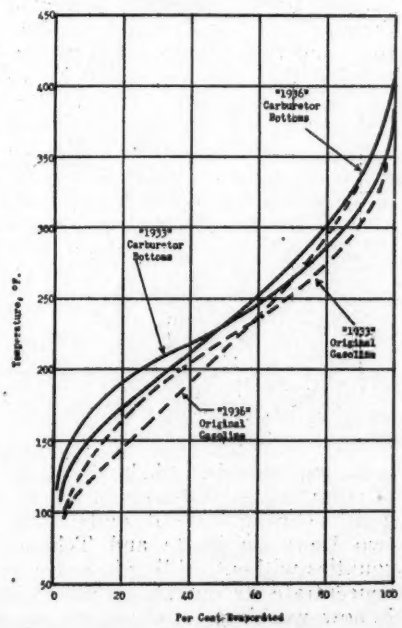
From the considerations discussed here it seems possible to conclude that a considerable increase in "front end" volatility of gasoline can safely be made by gasoline producers. Such an increase will undoubtedly be accepted by the motoring public without complaint inasmuch as it will be reflected in easier starting, more rapid warmup, and increased acceleration. Since it will be to the economic advantage of all gasoline producers to modify their products in this direction, it seems possible that there will be a universal tendency in this direction, and if the process is a gradual one, the decrease in economy will probably not give rise to any extensive complaint from the public.

Economy

However, the present trend in sales promotion in the automobile field is apparently toward stressing economy of operation. If this trend continues and if gasoline producers supply more and more volatile fuels

FIGURE 5

EFFECT OF VAPOR LOSS ON ENGLER DISTILLATION CURVES OF LABORATORY SUMMER GASOLINES



to the public, the effect will be to drive the automobile designer to take steps to decrease the temperatures experienced by the gasoline in the fuel systems of the cars of the future.

In conclusion we may sum up these considerations in the following manner:

1. Recent advances in design of automobile fuel systems make it possible for the gasoline producer to market much more volatile gasoline. This will increase the use of natural gasoline in motor fuels in the immediate future.

2. The introduction of such fuels to the market will increase the venting losses in automobiles and tend to direct the efforts of the automobile designer toward increasing economy by decreasing fuel line temperatures.

3. The combination of these trends will be to increase the percentage of natural gasoline in motor fuels over a long-time period.

TABLE I

Gasoline	Temperature of gasoline in "carburetor bowl" °F.	Loss % by volume
1933 Summer	139	13.7
1936 Summer	139	19.2
1933 Winter	110	11.2
1936 Winter	110	15.0

FOOTNOTES

[1] O. C. Bridgeman, H. S. White, and F. B. Gary, "The Vapor Handling Capacity of Automobile Fuel Systems," SAE Journal, 32, 157 (1933).

[2] N. MacCoull and E. M. Barber, "Vapor Locking Traits of Cars and Their Limitations on Gasoline Volatility," SAE Journal, 37, 237 (1935).

[3] E. M. Barber and B. A. Kulason, "The Correlation of Car and Fuel Vapor Locking Characteristics," SAE Journal, 39, 351 (1936).

■ ■ ■

A. H. Bell, general superintendent of production and drilling for the California Division, Continental Oil Co., spent last week visiting Bakersfield, North Belridge and other Continental properties on the coast.

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Buttes Oilfields Starts Fourth Test Of Lease In Northern California

NEAR MARYSVILLE, Sutter county, The Buttes Oilfields, Ltd., has started its No. 4 well continuing the work of prospecting and development it has been carrying on for several years. The location is 2200 ft. north and 1500 ft. west from the southeast corner of sec. 2, 15-1, which puts it on the south of an east-to-west fault referred to in a geologic report as "probable." Last week the well was reported as being down some 500 ft., and should be setting surface casing shortly.

Location of No. 4, which is some 2500 ft. north of No. 3, was made on the recommendation of Kenneth A. Johnston, Los Angeles geologist and geophysicist, after three other test wells had been drilled, geological and geophysical surveys made covering the region, and Schlumberger tests made of the formations. Mr. Johnston has recommended that "the hole be cored at intervals below 1000 ft. and possibly continuously below 1500, and that a formation test be made wherever favorable sand bodies appear," and also that "an electrical survey of the hole be made not only as an aid in setting casing, but also to assist in the interpretation of certain conditions existing in Well No. 3." Presumably, Mr. Johnston's recommendations will be followed.

Drilled Too Near Buttes

All three wells drilled by Buttes Oilfields Ltd. have discovered gas. Analysis has shown it to be wet, which points to oil somewhere in the region, whether it be in commercial quantities or not. The first two wells were found to have been too near the core of the Marysville Buttes, and their product was found to be only non-commercial seepage gas. Well No. 3 was located further out on the floor of the valley, two miles southeast of Nos. 1 and 2, and was drilled to 5341 ft., where it now stands suspended, and the company's last annual report says that it is the intention to resume work after completing No. 4. This report also advises that "a very good showing of oil was encountered while drilling No. 3 at 4966 ft., and gas showed strongly from 2700 ft. to bottom." From 4966 ft. to bottom the gas pressure was sufficient several times to threaten a disastrous blowout.

Casing was set in No. 3 at 4775, contrary to the advice of the Schlumberger Well Surveying Corp., because of the belief based upon a study of the cores and drilling data by a superintendent with world-wide experience that a possible productive sand had been passed through from 4775 to 4840, but a drill-stem test showed water to be coming from between 4775 to 4840. Schlumberger recommended setting casing at 4950. At the time the question was decided, nobody had had any actual previous experience in this area.

Gas Shutoff Behind Casing

Gas may have been shut off in Well No. 3 in the belief that the sands carried water only. Schlumberger tests, however, indicated them to have been "possibly productive" and that company has recommended that they be tested in future wells, according to the Buttes last annual report. Since the first Schlumberger report was made and before the issuance of the annual report quoted, the casing was perforated at points indicated as "possibly productive" and drill-stem tests conclusively showed, the annual report says, that the sands are gas-bearing. It is the intention to test these sands in No. 4, now drilling. It was impossible to determine the quantity of the gas by the tests made in No. 3 because of the presence of water.

Buttes Oilfields, Ltd., holds a total of more than 43,000 acres in this region. During 1936 it quitclaimed two leases in Butte and Tehama counties without drilling in order to concentrate its operations where it is now working.

■ ■ ■

The Chain Belt Co. announces the appointment of B. E. Sivyer, Jr. as branch manager of the company's San Francisco office to succeed the late G. E. Taylor.

When Mr. Sivyer joined the Chain Belt Co. a number of years ago, he was put in charge of the sales and development of Rex Z-Metal. Mr. Sivyer left the University of Wisconsin to enter the war. After returning to this country in 1918, he worked as general superintendent for the Northwestern Malleable Co. of Milwaukee and later for the Rockford Malleable Iron Co. of Rockford, Ill.

The San Francisco office of the Chain Belt Co. is located at 366 Brannan Street.

Southeast Limits To Mountain View Set

LIMITS to Mountain View's southeastern extension are being rapidly set by the failure of the Associated DiGiorgio No. 2, and the probable failure of the Mohawk's Earl Fruit Co. No. 2, sec. 10, 31-29, and of the Shell's Greer No. 1, sec. 15, 31-29. Associated has definitely abandoned its well. Mohawk's started to flow Nov. 2 at a 700-bbl. rate with a 75% cut, and in less than eight hours went completely to water. Efforts have been made to swab it in without much hope of success so far as last reports go. Shell's Greer came in Thursday last week as a 3,500,000-c.f. gasser with only a trace of oil, then after 17 hours flowing died completely. Swabbing produced only clear water.

Mohawk apparently accepts the results in Earl Fruit Co. No. 2 as final for sec. 10, and has started its Earl Fruit No. 3 335 ft. north and west of the southeast corner of sec. 3, 31-29, which is within about half a mile of production.

Below 7200 ft., G. P. at Arvin, sec. 26, 31-29, has had some more streaks of light oil sand in shale.

■ ■ ■

Geophysical Exploration Carried On In North

GEOPHYSICAL exploration on a large scale extending from Tracy to Stockton is being carried on by the Coast Exploration Co. of San Francisco, preparatory to drilling for gas or oil, presumably some time next year, according to available unofficial reports. The territory is decidedly interesting as gas has been found to the west at Tracy, to the east at Stockton and to the north in Solano county.

Stockton was the scene of the first gas wells drilled in California. Standard Oil's recent discoveries at McDonald Island have shown the existence of large deposits in the region where for some 40 years shallow wells produced small quantities used in Stockton. Quite recently several of these ancient wells have been officially abandoned, just as the new ones are coming in.

■ ■ ■

Kenda Well Produces

Kenda is getting 3148 bbls. per day from its No. 47-18J recently completed at 8931 ft.

Wilshire Recent Entrant Into Richfield Extension; Bachman Also Takes Leases

WILSHIRE IS ONE of several recent entrants to Richfield and its eastern extension. According to the Yorba Linda Star, Wilshire has paid landowners a bonus of $125 an acre and $1 monthly rental for acreage along both sides of Golden Avenue from Rose Drive to Valencia. The landowners understand that the first Wilshire well will be drilled on the old Gaudin place at the east end of the acreage, the second, if drilled, will be at the west end to prove the entire tract quickly.

Bachman Petroleum Corp., which has recently completed and put in service a new refinery at Signal Hill, has evidently decided that it must have a supply of crude oil from its own wells. It has entered upon a prospecting and producing career by acquiring a lease in the Kraemer area of Richfield, and has started the foundation for a derrick. The location is three miles northeast from Placentia, north of the Standard's Kraemer leases and wells, and around the mouth of Santa Ana Canyon.

West Coast Refining Co., drilling on sec. 225, 3-9, Santa Ana Canyon, north of the Standard's Kraemer wells, has plugged back from 2128 to 1400 ft. and is redrilling to straighten the hole.

At Placentia, the California Eastern Oil Co. is redrilling its Verdi No. 1, sec, 31, 3-9, within the city of Placentia, and is close to 3900 ft. The total depth is 4678 ft.

Main Field

In the main field, Union's Chapman No. 29 is now close to 8400 ft. While official reports are not given out by the company, unofficial advices are "not so hot," sand and shale with no mention of oil being the only word obtainable. Eleven-inch casing was set just below 2900. Three other Union Chapman wells are drilling: No. 33, down 4800; No. 36, down 3500; No. 37, down about 3400. Number 36 is reported to have had some oil sand, while No. 37 has cemented through perforations and was standing over the week end.

Kraemer Section

In the Kraemer section, Standard is drilling two wells, the first in several years. Its Kraemer No. 2-11 was standing cemented at 3330 with 8-inch casing, having been drilled to this point after plugging back from the bottom at 4300 ft. Standard is building road to the location for its No. 2-24 on Alta Vista Avenue.

Standard is the one company that has actual production in the Kraemer area. Nearly 20 years ago, an independent company drilled on what is now the Standard holdings. The story is told around that when the well was being tested a Standard drilling official came along, noted the well's showing, and made a personal friendly suggestion to the superintendent that he thought certain other tests would be almost sure to bring in a producer. The superintendent appears to have been a somewhat cocky individual and answered, "Whenever we want advice from the Standard Oil Co., we'll let you know." The tests were not made and the well was abandoned. The Standard man then reported to headquarters what he had seen and the big company acquired the quitclaimed lease and its first well was successful in proving the property.

■ ■ ■

Coyote Test Rigging Up

Graham & Loftus Oil Co. is rigging up to start the new deep test on its land in East Coyote which it was announced some time ago would be drilled. The well is Perkins No. 1, the location on the sw¼sw¼ sec. 18, 3-19.

New Operators Enter Huntington Beach Area

E. R. RUCHTI and Charles E. Black have entered the boom district on the East Side of Huntington Beach where they will join the hunt for the Dunlap sand. They have leased 2½ acres, block 2205, between Yorktown and Utica Streets. Drilling will be started shortly, under the direction of Mr. Black. Mr. Ruchti is one of the owners of a market in Southgate, and has previously been in oil.

On the Wilson lease, at Utica and Delaware Avenues, the Petroleum Co. is starting a new well, its Wilson No. 4, seeking the new Dunlap sand, and is starting to deepen an old well, Wilson No. 2, from a bottom of 3200 to 4000 where the Dunlap sand is found.

South Basin Oil Co. has reached a depth below 1600 ft. in its No. 93, located on its fee land, on part of which D. D. Dunlap drilled his discovery well on a sublease from South Basin.

Westport Oil Co. is getting 500 bbls. per day from its No. 5, at Toronto and Delaware, bottomed at 3970. The oil is 26 gravity, cut 3%.

E. J. Miley has returned to one of the scenes of his early operations and will drill for the Dunlap sand near the northeast corner of Huntington and Springfield. Foundation for his derrick has been completed.

D. D. Dunlap has the rig up for his second well near the southwest corner of Toronto and California.

In all, about 30 wells are in various stages of drilling, redrilling, preparing to drill, or getting ready to test for production in the Dunlap area.

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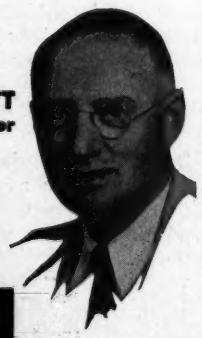
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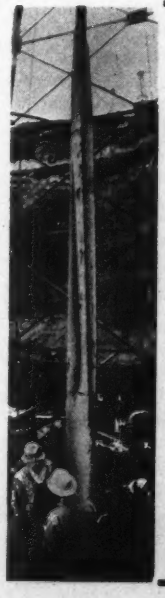
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Utilization Of Petroleum

(Continued from Page 15)

compounds at high temperatures, it was possible not only to understand the exact manner in which the decomposition proceeds, but also to obtain selective action by various catalysts.

We were able to establish, from the very beginning of our investigations, that some metals and their oxides promote "aldehyde" decomposition of alcohols; that other oxides promote "ethylene" decomposition; and that still other oxides make it possible to obtain diolefins from the alcohol.

A catalyst causes the decomposition of an organic compound to take a certain direction, due to its specific chemical and physical properties. Taking into consideration the most vital problems facing the petroleum industry, we believe that a new period of development has begun, viz., the catalyst period.

The necessity of introducing catalysis for obtaining various products from petroleum is evident from both the scientific and the economic points of view. We know that catalytic methods have great advantages, and they already occupy a firm place in chemical industry.

In the petroleum industry they will be perhaps even more important, since the reserves of this valuable raw material should be conserved by using them to better advantage. Therefore, the more rational utilization of petroleum constitutes a problem of great importance for the chemist as well as for the engineer.

You are well aware of the controversy concerning the extent of the petroleum reserves in the earth. This question, of course, is closely connected with the hypothesis of the origin of petroleum. I think that I am not mistaken in saying that the majority of chemists, geologists, and biologists accept the organic hypothesis of the origin of petroleum.

Have we sufficient ground to form conclusions as to the actual amount of the petroleum reserves? This has an important bearing on the rational utilization of crude oil. This question divides geologists and chemists into two groups. Some[3] consider that the petroleum reserves are very limited, and that in the United States there will be enough for only five to eight years. Others[4] insist that the petroleum reserves have been carefully estimated, and that there is no danger of shortage in the immediate future.

We think that both sides have arguments worthy of consideration.

Those who say that the petroleum reserves are small induce us to regard the use of it as fuel, as well as raw material, with greater care.

On the other hand, the data presented to prove that we possess enormous reserves of petroleum are not convincing. All previous estimations of the oil reserves in the Baku region proved to be wrong.[5] Economic methods of utilization must, therefore, be chosen; and, for this reason, catalysis must be introduced into the petroleum industry.

In order to convince you that the catalytic period has become a reality, we shall mention several catalytic processes which are in commercial operation.

Some of the reactions, viz., straight polymerization[6] and also selective and mixed[7] polymerization, are already applied on a large scale; and hundreds of thousands of barrels of excellent gasoline, with high octane number, are being produced in the United States by these reactions.

Although the method of polymerizations of olefins under pressure,[8] and without the use of a catalyst, is also employed in some plants, a careful consideration of the comparative merits of these two methods brings us to the conclusion that the catalytic method has numerous advantages over the method where temperature and pressure alone are used.

No one can deny that with the use of a catalyst we are able to produce, by means of selective polymerization and catalytic treatment of olefins, a very good yield of special gasoline for aviation. This gasoline has an octane number of about 100, without addition of any tetraethyl lead.

Polymerization at high pressures and temperatures, but without a catalyst, cannot produce such a good yield of aviation gasoline. Catalytic methods, with a carefully-selected catalyst, are sometimes actually capable of producing theoretical yields —which has never been possibly by pyrolysis. Catalytic methods permit us to select from the mixture of substances only those which we need, without ruining the others which can be subsequently utilized for polymerization.

When pyrolysis of paraffins, rather than catalytic dehydrogenation, is employed for the production of olefins, all the experiments and calculations show that the yield of the olefins is considerably lower, and that the hydrogen is contaminated by such gases as methane, ethane, etc., which diminishes its value for hydrogenation.

Another new and important catalytic reaction investigated in our laboratory is the direct alkylation of paraffins and naphthenes by the olefins.[9] This reaction is superior to the Friedel and Crafts reaction, which requires a preliminary preparation of alkyl halides and makes it possible to introduce the radicals into the molecules of certain hydrocarbons only through their agency.

For example, the alkylation of isobutane produces directly a good yield of isooctane having a high octane number. By this method we can produce various saturated hydrocarbons of isostructure, such as isoheptane, isodecane, etc. Data obtained in our laboratory give us the assurance that this process of synthesis of high-octane-number paraffins could be utilized on a commercial scale. The advantages of this method are obvious. Further investigations of this reaction undoubtedly will make it possible to commercialize this method, and we hope that the future industry will adopt it.

To further emphasize the importance of catalytic methods for the petroleum industry, we can compare the present "reforming" process for increasing the octane number of gasoline with proposed catalytic methods of auto-destructive alkylation and catalytic isomerization of hydrocarbons.

Undoubtedly, the reforming process considerably improves the quality of gasoline; but as with any pyrolysis, it is accompanied by the formation of gases such as methane, ethane, etc., and of other normal paraffins.

By merely subjecting hydrocarbons to further pyrolysis, we cannot utilize them as efficiently as by catalytic reactions with other hydrocarbons.

The more delicate method of catalytic destructive alkylation will allow us to treat saturated hydrocarbons in such a way that the gasoline produced will have a high octane number, and the gases will contain a very important hydrocarbon, isobutane, which is so desirable for alkylation. In the future the by-products of petroleum will be uti-

lized in a more efficient manner, and all waste will be eliminated.

Cracking, which at the present time is applied on such a large scale, will probably be modified by the introduction of catalysis. Since the various hydrocarbons contained in petroleum will require different conditions of time, temperatures, pressure, etc., for catalytic decomposition and isomerization, it is probable that "selective catalytic cracking" will be necessary—starting with specific distillates for each operation.

I shall not discuss, in this article, the high-boiling petroleum distillates from which lubricating oils are obtained. This branch of the petroleum industry has employed for a number of years the catalytic method of destructive hydrogenation for the purpose of obtaining good lubricating oils from petroleum distillates which otherwise had no application in industry. Also, the catalytic polymerization of olefins to synthetic lubricating oils, by means of active catalysts such as aluminum chloride, is being used.

The above examples are sufficient to convince us that further progress in the petroleum industry must be achieved by the introduction of catalytic methods so that this precious raw material, petroleum, which exists in the earth in limited quantity, may be utilized in the most rational manner. Recent scientific and technical publications, particularly in the United States and Russia, confirm the arrival of the "catalytic period" in the development of the petroleum industry, and it is evident that chemistry will be increasingly important.

Science does not stop in its development; and we may expect that, simultaneous with the growing application of catalysis in organic chemistry, there will appear new ways for the synthesis and decomposition of organic compounds.

I have in mind the role played by the ferments and enzymes, the so-called organic catalysts. Many such processes are being conducted on a large scale.[10]

It has been shown by Omelyanski [11] that the stable organic compound, cellulose, can be decomposed in two different directions by two different ferments. One of the decompositions yields hydrogen; and the other, methane. This selective fermentation is the product of the life process of two organisms, and requires no other energy. It may be possible to find such ferments which produce with petroleum hydrocarbons the reactions which are now carried out thermally and catalytically. From the material now available in this field of vitalism, we see that these processes are very economical and simple. Certainly, this is a method for the distant future. First, our laboratories and plants must develop and apply the methods of inorganic catalysis. At present we can only dream of vitalistic processes in the field of hydrocarbons.

Let us hope that in the future the petroleum industry will make good use of these methods of vitalism, just as at the present time it has successfully begun to apply the methods of inorganic catalysis in its processes.

[1]Baku, Russia, in the thirties of the last century.
[2]V. N. Ipatieff, *Catalytic Reactions at High Pressures and Temperatures*, Macmillan Co., New York (1936).
[3] Those who desire information on this question may find material in the following publications: Ipatieff, "Zur Frage uber die Entstehung der Naptha," *J. Pract. Chem.*, 84, 800 (1911). Ipatieff, "The Origin of Petroleum," *Petroleum*, 26, 118 (1911). Brooks, *J. Inst. Petroleum Tech.*, 20, 125 (1934).
[4] Snider and Brooks, "Petroleum Shortage and Its Alleviation." *Am. Chem. Soc.*, San Francisco meeting (1935).
[5] Garfias and Whetzel (Foreign Oil Dept.). *Petroleum Times*, 35, 487 (1936)
[6] Ipatieff, Corson, and Egloff, "Polymerization—A New Source of Gasoline," *Ind. Eng. Chem.*, 27, 1077 (1935).
[7] Ipatieff, *Ind. Eng. Chem.*, 27, 1067 (1935); Ipatieff and Pines, *ibid.*, 27, 1364 (1935); 28, 694 (1936); Ipatieff and Corson, *ibid.*, 28, 860 (936).
[8] The principle on which this method is based was discovered by the author (1905) who was the first to apply pressure for the polymerization of olefins. Ipatieff. *Catalytic Reactions at High Pressures and Temperatures*, Macmillian Co., New York (1936)
[9] Ipatieff and Groose, *J. Am. Chem. Soc.*, 57, 1616 (1915).
[10] Gabriel, *Ind. Eng. Chem.*, 20, 1063 (1928).
[11] Omelyanski, *Compt. rend.*, 121, 653 (1895); 125, 1131 (1897); *Arch. Sci. biolog., St. Petersburg*, 7, 411 (1900).

■ ■ ■

Midway Well Produces

The Texas Co. has developed a 650-bbl. well in its Fee No. 16, sec. 32, 32-24, Midway, from the Hallmark sand at 3037, with 105 ft. of oil sand. The well is considered a remarkable one, starting with an initial yield of 500 bbls., from which it has built up steadily to 650, which is quite high for this shallow area. Oil is 22.7 gravity.

Texas has No. 15 underway at present on this property. Last reported depth was 420 ft.

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R. R. (Bob) Morris has been appointed by the A. O. Smith Corp., of Milwaukee, as its California sales representative for electric welded surface casing. Mr. Morris will maintain his headquarters at the Los Angeles office of The Republic Supply Co., 2122 East Seventh St. Mr. Morris has had wide experience in the California supply company industry and has recently been the oil country sales representative of the Broderick & Bascom Rope Co.

Shell Suit Against Kenda Now Under Way

THE LONG AWAITED Shell-Armstrong suit against Kenda finally got under way last Wednesday in Judge Minor Moore's court. Due to the size of the crowd anxious to attend the proceedings, the court was moved from the city hall to the California Oil and Gas Association Chambers.

Mr. Beck, of the Shell Oil Co., gave the opening argument for the plaintiffs. The first witness called for Shell-Armstrong was Harry Johnson.

The case, which is expected to continue for several months, involves many of the major companies and will undoubtedly prove to be one of the most elaborately prepared and costly court trials to be held in California in recent years. Both sides have called upon some of the best legal and technical talent available in an attempt to bring clear-cut issues out of an extremely complicated situation. The suit was brought by Shell-Armstrong in protest to reclassification of certain acreage, without, as the plaintiffs contended, sufficient information having been procured by means of the drill before such reclassification was made. While the property under discussion totals approximately 500 acres, it is believed in many quarters that should the present suit be upheld by the court, thousands of acres of additional land will eventually be drawn into litigation.

As the Investment Banker Views the Petroleum Industry

By KINZIE MILLER
MITCHUM, TULLY & CO., LOS ANGELES

IN THIRTY years the petroleum industry has risen from minor importance to an essential major industry. Not only has it converted a single natural resource into wealth at a more rapid rate than ever before witnessed, but it has made more than 2000 products derived from crude petroleum essential to the existence of many of the other leading industries of the nation.

In accomplishing this, an industry has been created with an invested capital exceeding 13 billion dollars, approximately a million man payroll, and an annual tax bill of about 1⅛ billion dollars.

In spite of this, companies have been constantly beset by financial problems, which may be traced both to the nature of the business and competitive factors let loose by the forced dissolution of the old Standard Oil Co. of New Jersey by Supreme Court decree of 1911.

The major phases of operations are production of crude material, refining, and marketing of finished products. Although both production and marketing are maintained under conditions of extreme competition, from the standpoint of the economist the underlying factors in the two operations are basically different.

Fundamentally, the crude oil side of the business rates as an extractive industry. While subject to all of the problems of this type of business, the situation is further complicated by the fluid state of the raw material, a condition not existent in other extractive industries.

Profits of the Industry

Like any industry of this type, profit is dependent solely upon the residual sums left after the expenses of processing and distribution have been taken out of the sale price of the finished product. In the long run that price will be determined by the law of supply and demand, no matter what artificial barriers may be superimposed for temporary periods. Flush production is bound to mean low crude prices for the industry as a whole. Even if prices are maintained at the well, and excess production is stored, eventually the cost of that storage must be deducted from the net sum realized from the raw material. Partially offsetting this is the fact that recovery costs are lowest in flush fields.

While much has been heard about this phase of things, little attention has been given to the factors which are now reducing the problems of competitive production of crude oil. During the 1923 to 1930 period, characterized by flush production in new fields and easy money conditions, it was easy for the small operator to sink independent wells, thereby disrupting production. Plentiful capital was available for small refineries. The demand of these concerns for cheap crude made it difficult for the large units to control production.

The depression has materially changed this picture. Today the sixteen outstanding companies have direct control of one-half of the nation's production. Another 30 to 40 per cent is under their control indirectly, through pipe lines and purchasing contracts. True, competition between them is keen; the 10 to 20 percent of production not subject to their control is a threat to the market, new flush pools and increasing availability of speculative funds could disrupt the situation; but even this last danger is not excessive, as the larger companies are aggressively active in leasing major control of potential fields.

Competition must be maintained to conform to national law, in spite of all the factors which argue for the economic soundness of regulated monopoly in this field. However, national recognition of the desirability of conservation of a natural resource is permitting increasing cooperative action through proration agreements, etc.

In addition, the type of competition apt to exist in the future between a small group of large companies promises to be much sounder than the type found in the palmy boom days of the small inexperienced operators.

Refining Situation

The refining situation is comparatively simple. It might be argued that a rated refining capacity of 4 million barrels daily is excessive for an industry with only about 12 or 13 billion barrels of proven reserves, an 8 to 9 year supply for existing refineries. Here again, the actual situation is better than that shown by surface figures.

Many of the small independent refineries were thrown together cheaply during days of profitless prosperity. Today their physical condition is steadily lessening their threat to orderly refining operations. A tightening in crude prices or reduction in supplies, over any extended period, could easily eliminate many of them.

Further, the process of integration of control noted in the crude field, has been evident here, so that the few major companies now own about 70 per cent of the active refining capacity. The superiority of their plants means that they have an even greater than 70 per cent domination of this field.

Marketing Complications

The marketing field is complicated by several problems. Indications are that less progress has been made here than at any other point. While over 2000 products, ranging from fuel oil to medicinal products and cosmetics, are marketed; while industry after industry is dependent upon the business to keep wheels turning; nevertheless, major marketing operations are geared to the gasoline field.

Consumption of gasoline approximated 17¾ billion gallons in 1935, about a 6½ per cent gain over 1931, the previous record year. Fuel oil consumption, second in importance, also is gaining steadily. Yet profits are far from satisfactory, in spite of striking gains in net during the first half of 1936.

The cause for this is probably found in three situations, namely, competition within the business; consumer opposition to increased prices; and fear of federal control

should the price structure be raised materially. The first two are probably more potent currently than the last.

Effect of Competition

Competition is the factor which has been largely responsible for the investment in marketing facilities of over 3 billion dollars, and the existence of over 170,000 gasoline stations in the nation. While averages are deceiving, they still indicate trends. They show that the average service station is working on less than 300 gallons of gasoline a day, insufficient to produce wages for the average operator. Not only this, but the cost of distribution is excessively high because of this situation. The fact that over 70 per cent of the number of employees is engaged in marketing operations may be partially attributed to this wasteful distributing system, induced by excessive competition.

It would seem that the major operators had the power to reduce this hazard, if not eliminate it, through reasonable cooperation, while still maintaining aggressive marketing competition. One thing they definitely could accomplish is the elimination of "back door" marketing of surplus stocks. With refining control increasingly favorable to major companies, they have more power than they use to prevent so-called bootleg gasoline from breaking their own markets.

Taxes vs. Consumption

Consumer resistance to price increases involves the whole taxation situation. Conceived as a lucrative, easily collectible sales tax, gasoline taxes have become a definite cost, which cannot be passed on to the user in price increases. No matter how prices are posted, the motorist conceives of himself as paying a flat price for motor fuel. He does not break this down into its component parts. If he will absorb a maximum supply of gasoline at 18 cents a gallon, 18 cents will have to be the price, no matter if gasoline tax is increased or lowered two or three cents. So the ever-increasing gasoline and other marketing taxes, responsible for almost 80 per cent of the industry's tax bill, become, not sales, but industry taxes.

Since taxes today average about 5.3 cents per gallon of gasoline, or almost 30 per cent of average consumer cost, this item is the biggest single factor in the price structure, with the battle waging between the political desire for easily collected taxes and the consumer's demand for low prices, and the oil companies holding the sack.

But even here, the situation is not entirely drab. Several states are discovering that further increases in rates are reducing the tax income. Recognition that rates are at about the maximum the traffic will bear, is slowly making itself felt. There are grounds for believing that those tax burdens which are peculiar to the industry may be approaching a reasonably static level.

In such events, internal operating economies and elimination of the problems of cut-throat competition point the way to profitable marketing operations. The industry is so important to the nation that, unless this is accomplished through self-regulation, there is a positive, though at present rather passive, threat of its being accomplished under Federal supervision, with all the undesirable features of government regimentation.

In short, the petroleum industry is an extractive business, supplying essential products on a vast scale. Its growth has been phenomenal. It is beset with problems, but they are far from unsurmountable. It is in a better financial position than at any time in its history.

If the industry can clean up its internal problems and build on its currently reasonably satisfactory base, its future has definite promise for more healthy prosperity than it has ever enjoyed. There are definite indications that consumption of all the principal petroleum products will extend materially over the next several years. This is particularly true in the case of gasoline and fuel oil.

With increasingly sound capital structures, expanding business, and control of competition, it should need only a moderate increase in price structures to create rapid expansion in per share earnings of soundly financed companies.

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W. D. (Dale) Russell has been appointed oil country sales representative of the Broderick & Bascom Rope Co., of St. Louis. Mr. Russell will make his headquarters at the Los Angeles office of The Republic Supply Co., 2122 East Seventh St. Mr. Russell is well known to the industry, having been in the employ of the Republic Supply Co. for many years, and later on with The Youngstown Sheet and Tube Co., working in conjunction with The Republic Supply Co. sales department.

Geologists Hold 13th Annual Meeting

(Continued from Page 4)

Paleontologists and Mineralogists held their dinner at the Mona Lisa. A business meeting was held, after which L. W. LeRoy presented a paper entitled "Foraminiferal Faunule from the Vaqueros Formation of the Simi Valley."

New Officers Chosen

At the Friday afternoon business meeting, new officers of the Pacific Section of the A. A. P. G. were elected. Harry R. Johnson, consulting geologist, was elected president, and James C. Kimble of the General Petroleum Corp. was elected secretary-treasurer. Last week's meeting was held under the direction of the old officers, Chester Cassell, president, and Richard G. Reese, secretary-treasurer.

Other papers presented at the meeting included a discussion of the "Sycamore Canyon Formation" by Max L. Krueger, the "Geology of the Outfall Sewer Tunnel, Palos Verde Hills," by J. R. Schultz, "Relation of Type Santa Margarita to Type Monterey, California," by J. Edmund Eaton, "The Stratigraphy of the Tesla Quadrangle near Tracy, California" by Arthur S. Huey, and a paper on "Geological Prospecting in New Guinea" by W. E. Heater.

The meeting closed with a dinner dance at the Biltmore Friday evening, at which more than 200 couples were present. The next special meeting of the American Association of Petroleum Geologists will be held at the Biltmore Hotel on March 17, 18, and 19, which will be the occasion for the national meeting of the A. A. P. G. as well as that of the Pacific Coast Section. Frank Morgan, Rio Grande Oil Co., was made general chairman, while Roy Barnes, Continental Oil Co., was appointed publicity chairman.

■ ■ ■

As a result of the decision to increase the number of directors by two on Jan. 1, when Sir Henri Deterding retires as Managing Director of Royal Dutch Petroleum Co. and its affiliations, including Shell Trading & Transport Co., Baron J. C. Eck, who was first president of Shell of California and later of Shell Union Oil Co., becomes a director of the parent company with headquarters at The Hague, Holland. J. M. De Booy is the other new director. Dr. J. E. F. De Kok succeeds Sir Henri as the head of the huge international oil combine.

High Temperature Corrosion In Refineries

(Continued from Page 9)

of ammonium hydrosulfide, its use would be indicated. In practice it has shown itself inadequate and practically ineffective, but its use gave protection in the low-temperature portions of the plant by passing over with the distillates.

Protection by Means of "Films"

The application of films for the purpose of protection from corrosion is a familiar matter in regard to atmospheric corrosion, which is discussed later under the question of low-temperature corrosion. The problem of protective films under high-temperature conditions needs to be examined from another angle.

The most illuminating example of protection by films in the refinery is found where films of coke are formed, such as in still tubes and high-temperature drums. These films prevent contact of the oil with the metal, but suffer from the defects of other film-protection methods. The films of coke are highly non-conducting and, hence, tend to cause overheating the tubes; they are porous and, hence, permit the slow diffusion of oil to attack the metal. They increase rapidly in thickness, due to the increasing temperature, etc., until finally their thickness becomes such that a shut-down is necessary for their removal.

In addition to these decomposition films there are corrosion films to consider. The remarkable resistance to corrosion of the chromium alloys has been attributed to the formation of protective corrosion films. This view is probably erroneous. As discussed above, the working temperature is below that at which chromium is attacked readily by sulfur. Some metals such as iron, as shown by various researches, are attacked at comparatively low temperatures; and others, such as copper and silver, at atmospheric temperatures.

In the case of aluminum which forms an oxide readily in the air, the oxide being relatively insoluble in water, a protective surface is formed on the aluminum. Similarly, there is the well-known "passive" state in which a metal, like iron, for eyample, in a strong acid is protected by the formation of an oxide film or high oxygen - metal - concentration film. While this is true in these cases, the application of this theory to other cases where other factors of greater importance are present has been overdone. The extent to which this has been carried may be realized by the fact that it has been considered necessary to reduce the thickness of the protective film to a few molecules of thickness, owing to lack of evidence of its presence; whereas the straightforward explanation that the conditions present do not warrant any action is often ignored. Insofar as protective films formed by oxidation of the metal are concerned, they may be dismissed when considering the lesser corrosive action occurring when a chromium alloy is substituted for a plain carbon or a nickel steel. The explanation of the superior resistance of chromium to sulfur and acid corrosion is probably due to its more inert character at the temperature now used than to its forming protective films on its surface.

Whatever explanation is found ultimately to be the correct one, the influence of the protection afforded by increasing chromium content is undoubted.

Recommendation for Lines of Investigation

Progress is essentially the result of an attitude of mind combined with an adequate grasp of the fundamental facts. For example, in considering high-temperature corrosion, it has been shown that the metals may be arranged in order of the heat of formation of their oxides, and consideration of these figures would indicate the usefulness of investigating nickel alloys as high-temperature corrosion - resisting metals. On the other hand, the influence of nickel on the mechanical properties is a well established fact; and, hence, it may be necessary to incorporate this element in an alloy for the mechanical effect of increasing the elasticity of a hard material.

The recommendations for lines of investigation in connection with the suppression of high - temperature corrosion may be considered under the following sections:

Distilling Process
Structure of Plant
Composition of Metal or Other Materials of Construction.

Distilling Process

The fundamental requirements for a distilling process are heat and reduced pressure. The function of the application of heat is to raise the vapor pressure of the liquid to that of the atmosphere; at this vapor pressure the liquid boils. This can be assisted by reducing the pressure of the atmophere in the distilling vessel or by the application of Dalton's law. In recent years the principle of reducing the pressure of the atmosphere has been applied to bubble towers, some of which work under high vacuum.

The majority of the stills in modern practice demand a high pressure to give a rapid flow through the tubes, of the order of 13 ft. per sec., and also for other reasons—hence, the higher rate of corrosion from sulfur and sulfur compounds, whose activity appears to bear a definite relation to pressure. As far as the process is concerned in relation to corrosion, the following investigations are suggested:

The solubility of sulfur and sulfur compounds in various crudes.

The fundamental nature of the sulfur compounds in the various crudes and their physical and chemical characteristics. Some work has already been done on the first and second investigations.

Variation of solubility of sulfur and sulfur compounds in the crude with temperature and pressure.

Based upon the first and third, investigation of the problem of bleeding the sulfur after the preheater.

Investigation of the nature of the reaction with neutralizers in presence and absence of water. An examination of the condition of the sulfur in the coke would, no doubt, assist in elucidating the function which water is performing in the corrosion, if any.

Assuming for the moment that water plays a part in the high-temperature corrosion, investigation of methods of removal of water seems desirable.

Structure of Plant

The development of the tube still in modern times has shown a grasp of the fundamentals of heating a liquid by increasing the surface exposed to radiant heat in relation to the volume. Apart from its influence on the product of distillation, pressure has been applied to give a volume efficiency, etc., to the plant resulting in increased corrosion. Possible modifications of plant structure insofar as it may affect corrosion should be considered.

Tube headers are shown by the corrosion reports to have excessive corrosion due to turbulence at these points. A study of the influence of the form of header is indicated, and tests would be usefully made on the

comparative influence of circular headers and parabolic headers. These two types of headers could be constructed in glass by people who have experience in heavy-glass-tube manufacture for industrial use. Actual visual observation of the character of the phenomena of turbulence could be studied in this manner.

The influence of coke upon the rise in temperature in the metal of the tubes is well known. The allowable thickness of coke deposit for the various steels is also known, varying from about 0.05 in. for a carbon steel to as high as 0.4 in. for some of the special steels—this allowable thickness of coke depending upon the creep strength of the steel. It might, therefore, be of value to know the relation between tube diameter and coke formation for the various crudes at various speeds of flow, and also the temperature and pressure relations for coke formation with various crudes.

The nature of the passage of the corrosive sulfur and sulfur compounds through the oil film, and subsequent coke deposit in still tubes, would also appear to be of value to the refiner. Is the process of sulfur corrosion taking place through the protective coke skin one of diffusion or chemical decomposition? Thus a knowledge of this question might assist in the solution of the corrosion problem by introducing a protective skin of different character, but of high heat conductivity such as is brought about when using lime as a neutralizer—the alkali in the coke deposit forming a chemical trap for the corrosive sulfur.

Deposition of coke and similar formations on surfaces depends not only upon the temperatures of decomposition, but also upon the chemical nature of the contacting metal and the physical nature of the surface of the metal. It would, therefore, be desirable to investigate the nature of the metals and surfaces upon which coke does and does not deposit. The nature of the metal is the most important factor.

For example, a highly-carbonized metal surface is more resistant to deposits in general, and also is closer in texture. An investigation, therefore, of interior carburized tubes would suggest itself.

Composition of the Metal

In the general discussion of corrosion it has been shown how the application of fundamental chemical and metallurgical principles may be used as a guide in the selection of metals and also in experimental work in the suppression of corrosion.

Keeping in view the questions of mechanical strength and economy of capital cost of plant, the basic material of construction has been mild steel. This has been alloyed with various elements such as chromium and aluminum. The high resisting qualities of aluminum to sulfur attack are well known to refiners; and, therefore, a close study of the related elements would be of value. The element titanium—which has been given third place in the series aluminum, chromium, titanium — would indicate the desirability of a concentrated study of titanium steels.

Perhaps more important is the study of the silicon alloys. If a method can be found of impregnating the surface of a strong carbon steel with silicon, thus combining the highly-corrosion-resistant silicon alloys with a backing of strong metal, a widely useful material would be in the hands of the refining industry. The possible low price of such a volume product would enable it to be used in the high-temperature and low-temperature parts of the plant, and it offers the solution of many phases of the corrosion problem.

Since the writing of the above paragraph, a process has been found to accomplish the impregnation of steel with silicon. Bubble caps and tubes up to 6 ft. long are being tried out, and the results will be watched with interest.

[1] Retailliau and Lang, *Pro. A. P. I.* 10 (III), 158 (1929).

[2] Wood, Sheely, and Trusty, *Ind. Eng. Chem.* 17, 798 (1925).

[3] Wilson and Bahlke, *Ind. Eng. Chem.* 17, 355 (1925).

[4] Seligman and Williams, *J. Soc. Chem. Ind.* 35, 88 (1916).

[5] A. Vuiborov, *Azerboijanskov Neftianoo Khoziaistvs*, 9 (105), 117 (1930).

[6] A. L. Blount, *Proc. A. P. I.* 11 (III), 102 (1930).

[7] Williams and Homerberg, *Chem. Inst. Eng.* 16, 589 (1924).

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South L. A. Well Reopened

Calizoo Oil Co. will redrill and deepen, for a complete test, the Pacific Development Co.'s Saulque No. 1 at 128th and Central Avenue, South Los Angeles, which has stood idle for the past three or four years. Clinton Miller, who operates the Pacific Lock Co., is president; J. H. Johnson, service manager at Buffum's store at Long Beach, vice-president; A. G. Burkenhager, superintendent. The well is a wildcat.

Standard Oil Profit Shows Good Gain

STANDARD OIL of California, in company with other oil companies, reports higher income and profit for the quarter ended Sept. 30, as well as for the 9-month period of 1936, as compared with 1935. The regular quarterly dividend of 25 cents has been declared, along with an extra dividend of five cents per share.

Operating income for the quarter was $12,375,537.67, as compared with $9,653,834.91 for the same quarter of 1935, and was $30,057,-265.93 for the 9-month period as compared with $29,136,384.52 for the same period of 1935.

Dividends paid to the company during the quarter amounted to $311,093.02 as against $367,232.99; during nine months to $825,059.68 compared with $619,823.12. Other non-operating net income was $8077.92 during the quarter, as against $2079.62 in 1935; for the nine months they totaled $369,143.35 as against $206,759.28.

Total net income was $12,694,-708.61 during the quarter, against $10,023,147.52; during the nine months, net income was $31,251,-468.96 in 1936, against $29,962,-966.92. After charges including depreciation, depletion, and amortization, these figures are brought down to gross profits of $8,269,528.23 for the 1936 quarter, as against $5,515,-858.82 for 1935; and to $17,936,-073.81 for the 9-month period of 1936, against $16,879,000.78 during 1935.

After provisions for Federal income tax, but without any provision for surtaxes on undistributed earnings under the 1936 Revenue act, net profit for the third quarter of 1936 was $7,685,528.23, or 58 cents per share, against $5,175,858.82, or 39 cents per share during the same period of 1935. For the first nine months of 1936, net profit was $16,-665,073.81, or $1.27 per share, against $15,759,000.78, or $1.20 per share during the first nine months of 1935.

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Dumas-Lewis 2 Producing

Dumas-Lewis' No. 2, recompleted Monday last week, has been cleaning up rapidly and is reported to be pumping approximately 200 bbls. of 17-gravity oil. No. 3, offsetting the Walkin flowing wells and Petrol No. 1, spudded the last of last week.

Solano Well Down 3900 Ft.

Amerada Petroleum's Hamilton No. 1, sec. 26, 4n-2e, Solano county, is drilling ahead below 3900 ft. Thirteen-inch surface casing was set at 610 ft., leaving open hole below.

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Gasoline powered rotary complete with 2400-ft. 4-in. drill pipe. Located in Valley. Box 716, Santa Fe Springs, Calif. or phone Whittier 431-82. 11-12

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New gusher oil fields still to be found in Calif. Have perfect Dome Structure never drilled. Fully geologized. Large acreage. Favorable Lease. Taylor, 6618 Seville Ave., Huntington Park, Calif. 11-26

WANTED

Wanted an individual or company to assume (drilling obligations under terms of) a community lease covering valuable gas lands. Shallow depths east of Kettleman Hills. Write for particulars. Mrs. Beatrice M. Strong, 2070 Pacific Ave., San Francisco, Calif. 12-3.

The Secretary of the Interior, Washington, October 30, 1936. Advertisement—call for bids to purchase royalty oil accruing to the United States from the Salt Creek, Wyoming, oilfield. Sealed proposals, in duplicate, will be received in the office of the Secretary of the Interior, Washington, D.C., on or before noon, December 1, 1936, from responsible bidders for the purchase, beginning January 1, 1937, of royalty oil accruing to the United States from Government lands in the Salt Creek, Wyoming oil field. Detailed specifications on quantities offered for sale, required form of bids, deliveries, volume measurements, gravity determinations, bond requirements, and action on bids, should be obtained by prospective bidders from the Director, U. S. Geological Survey, Department of the Interior, Washington, D. C., the Supervisor, U. S. Geological Survey, Casper, Wyoming, or the Register, U. S. Land Office, Cheyenne, Wyoming. Sealed bids are to be submitted to the Secretary, Department of the Interior, Washington, D. C., pursuant to the specifications, the envelope to be marked plainly "Bid on Salt Creek Royalty Oil." No bid received after the time fixed herein for submitting bids will be considered. Secretary of the Interior, October 30, 1936. 11-26

WANTED FOR CASH

Wanted for cash, 5,000 ft. of 8⅝ inch 36 or 38 lb., Seamless Casing. Must be as good as new. The Buttels Oilfields, Inc., Syndicate Bldg., Oakland. tf

FOR SALE

Producing oil well, known as "Bay Oil Well No. 1," located at 20th and Junipero Sts., Signal Hill (Lot 9, Block 5, Signal Hill). Submit bids on or before Nov. 25, 1936, and for further information make inquiry of, Charles G. Kibbe, Jr., 625 First National Building, or 3073 Cherry Ave., Long Beach, California. Telephone No. 624-48 or 481-81. 11-19

Business and Professional Directory

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